NOAA WIND PROFILER

GUIDE TO LRU REPLACEMENT
For 404 MHz Systems

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1 Introduction

The National Oceanic and Atmospheric Administration (NOAA) Profiler Network (NPN) consists of 32 404 MHz Doppler radars located in the central United States, 3 449 MHz Doppler radars located in Alaska, and an engineering test bed at the National Reconditioning Center (NRC) in Kansas City, Missouri. Figure 1-1 is a map showing the locations of NPN profiler sites in the central US. Figure 1-2 is a map showing the locations of the Alaskan 449 MHz profiler sites. The central US profiler network completed deployment in 1992, and has been operating for eight years.

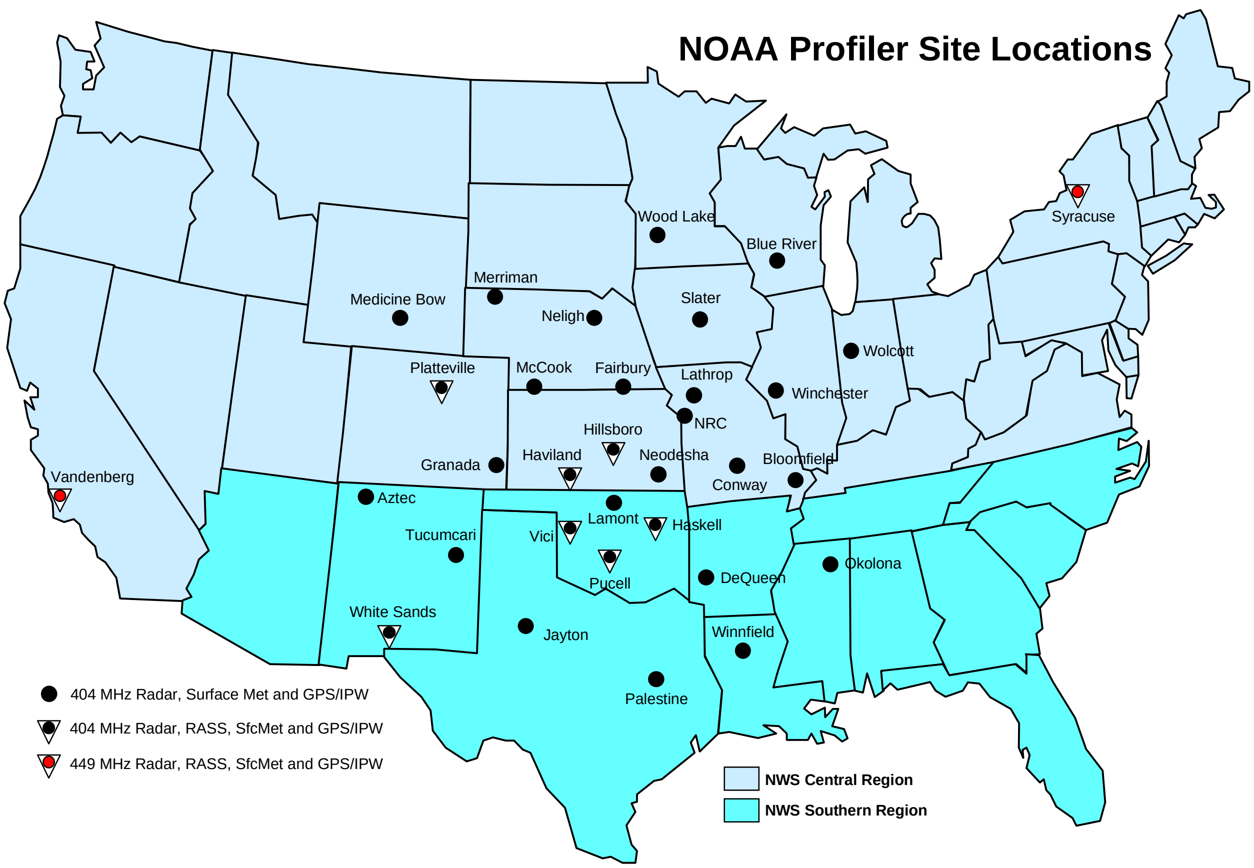


Figure 1-1 NOAA Profiler Site Locations

NPN profilers operate at a frequency of 404.37 MHz or 449.0 MHz and provide vertical profiles of atmospheric winds from altitudes of approximately 0.5 - 16.25 km. Wind measurements are made every six minutes and hourly averages are calculated. Figure 1-3 is a generalized block diagram of a NOAA wind profiler illustrating the major system components and their interfaces.

Data acquired by the wind profilers are transmitted to the Profiler Control Center (PCC) in Boulder, Colorado, for processing and quality control checks. As described in Figure 1-4, the PCC transmits raw or processed data to a variety of users, most notably the National Weather Service (NWS) via the National Weather Service Telecommunications Gateway (NWSTG).

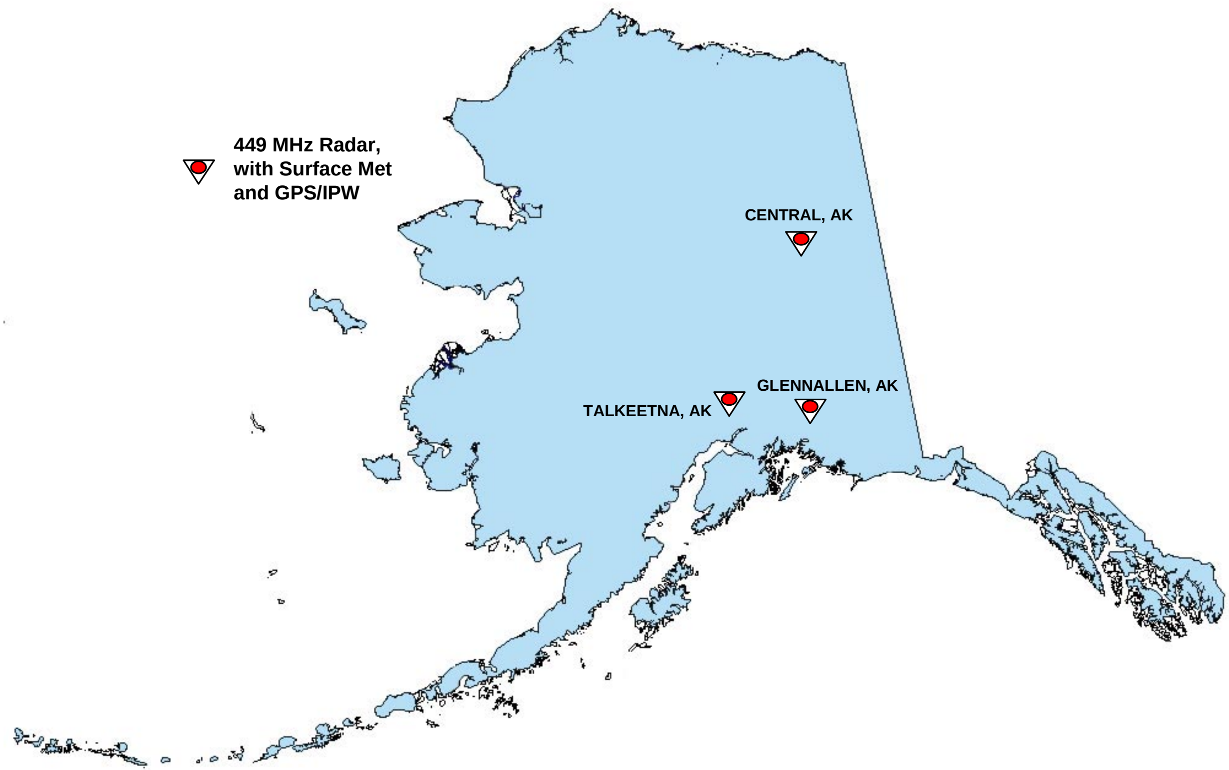


Figure 1-2 Alaskan 449 MHz Profiler Network

Under an agreement between NOAA's Environmental Research Laboratories (ERL) and NWS, dated March 1988, field maintenance of the WPDN is provided by NWS Electronics Technicians (El-Techs) and training and technical assistance in support of NWS maintenance activities is provided by the Profiler Program Office (PPO) in Boulder.

1.1 Purpose

The purpose of this manual is to provide NWS El-Techs and other field maintenance personnel with a comprehensive guide to the maintenance and repair of NPN radars. All NWS field personnel responsible for profiler maintenance should possess a copy of this manual, and one copy should be located at each profiler site.

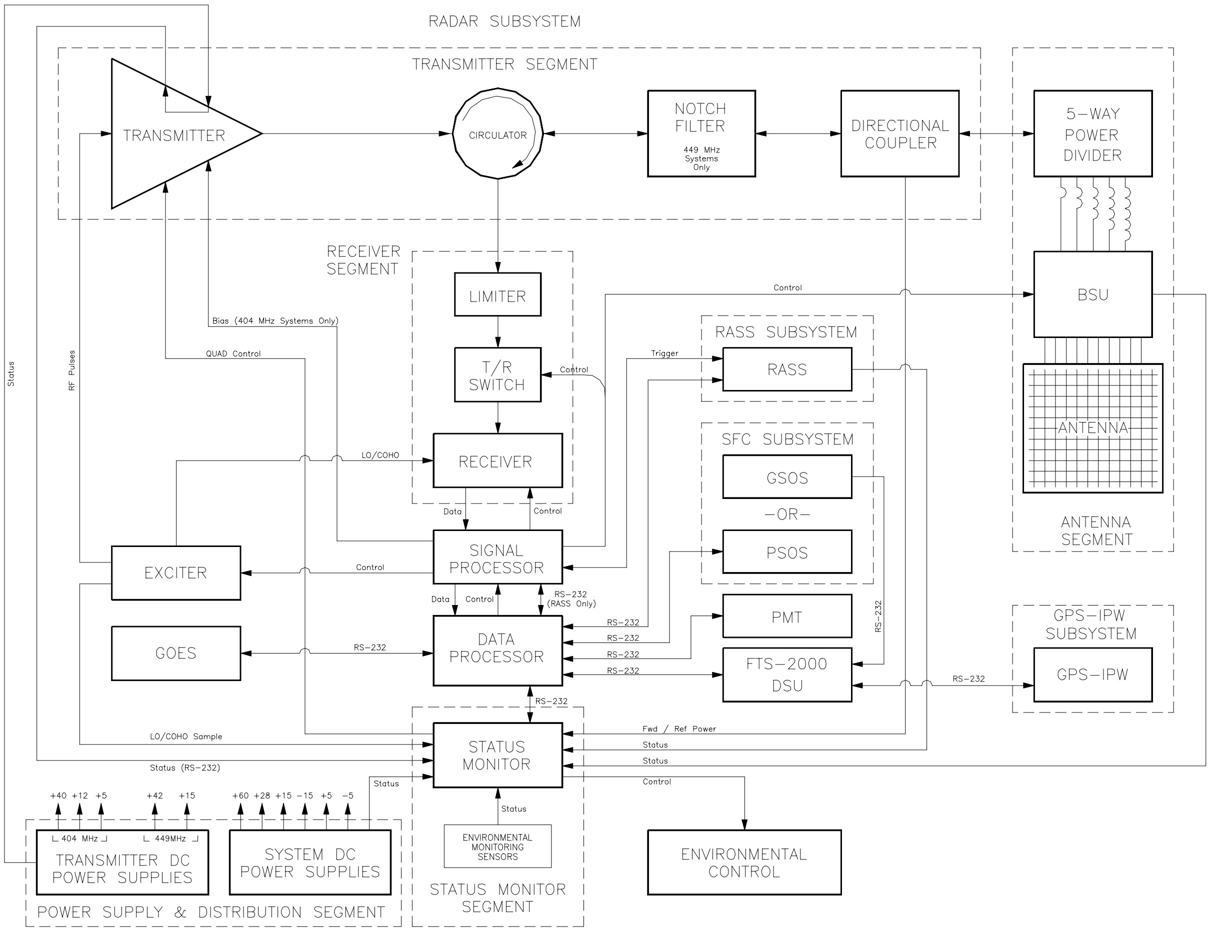


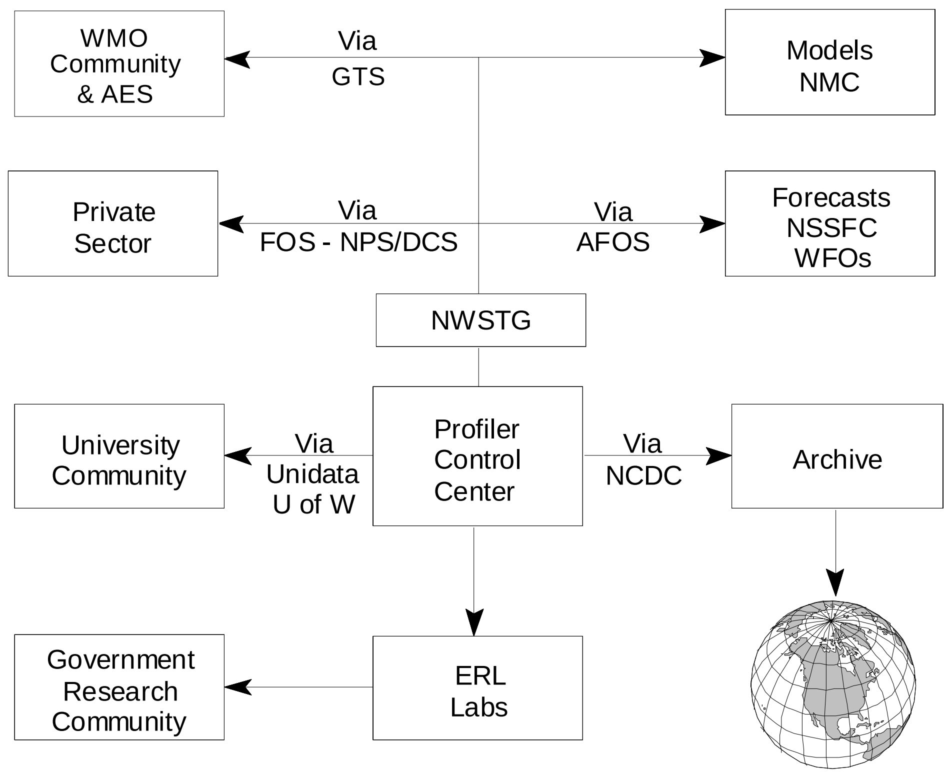
Figure 1-3 NOAA Profiler System Block Diagram

1.2 NPN Field Maintenance Cycle

Most field maintenance activities conducted by NWS El-Techs involve the removal and replacement of Line Replaceable Units (LRUs) or sub-LRU components. Approximately 100 items are stocked at the National Logistics and Support Center (NLSC) in Kansas City, Missouri, for NPN field maintenance activities.

The normal field maintenance cycle for an LRU replacement begins when the PCC observes an event using the remote diagnostic features of the NOAA Wind Profiler. Events diagnosed as faults are logged in a data base and the PCC staff contacts the designated maintenance personnel for each profiler site.

The PCC advises them of the failure and requests an NWS Equipment Maintenance Document (WS Form A-26) number for this event. PCC personnel contact the NLSC to request that an LRU be sent to the El-Tech at a designated location. The PCC then coordinates with the appropriate NWS maintenance person to schedule a site visit.



AES - Atmospheric Environment Service of Canada

Figure 1-4 NOAA Profiler Network Data Distribution

In most cases, repair of the profiler is a straightforward process. On occasion, however, the PCC is not able to determine the exact cause of a profiler failure using the remote diagnostics, and the maintenance person will be requested to assist in troubleshooting the problem. Under these circumstances, NWS field maintenance personnel will work closely with the PCC to diagnose the fault and take remedial action.

Some LRUs require calibration after installation, and when required, these procedures are included as part of the replacement procedures in the manual. If special equipment is required, it will be shipped to the El-Tech along with the LRU. The PCC will work with

NWS field maintenance personnel to assist in the calibration process and verify the results upon completion.

At the conclusion of the field maintenance activity, NWS El-Techs will return all damaged LRUs (repairable items only), calibration equipment, and unused shipped items to NRC according to standard NWS procedures, or to the PCC upon request.

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2 Shelter and Power Interfaces

This section focuses on the internal layout of the shelter and the AC power distribution and interfaces.

2.1 Shelter Layout

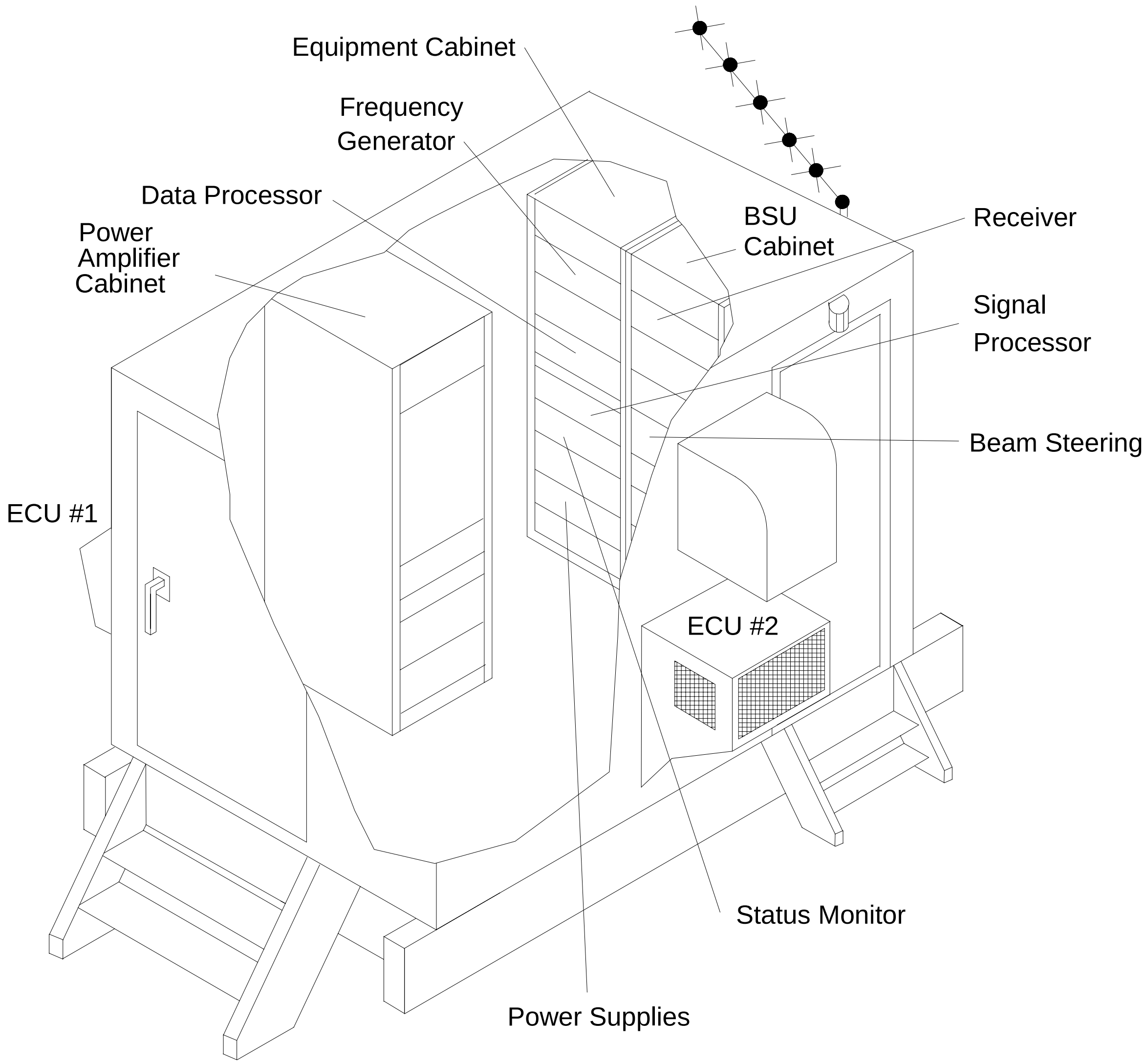


Figure 2-1 Wind Profiler Shelter

Figures 2-1 through 2-5 provide views of the four shelter walls and ceiling, and identify the major components within the NOAA Wind Profiler Shelter Assembly.

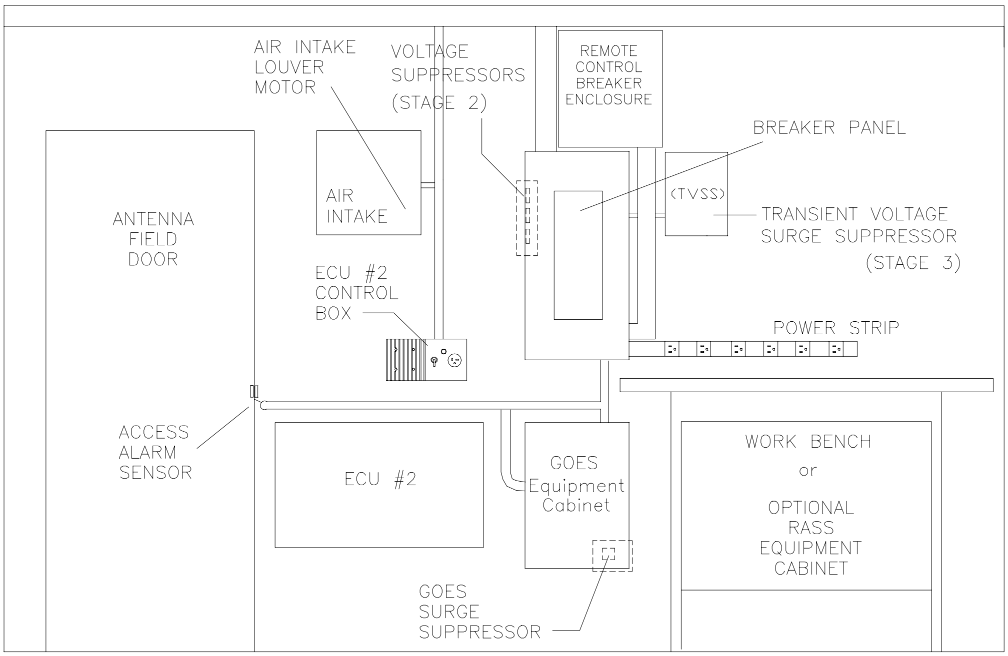


Figure 2-2 Shelter Layout Side 1

* NOT ALL PROFILERS ARE EQUIPPED WITH PSOS

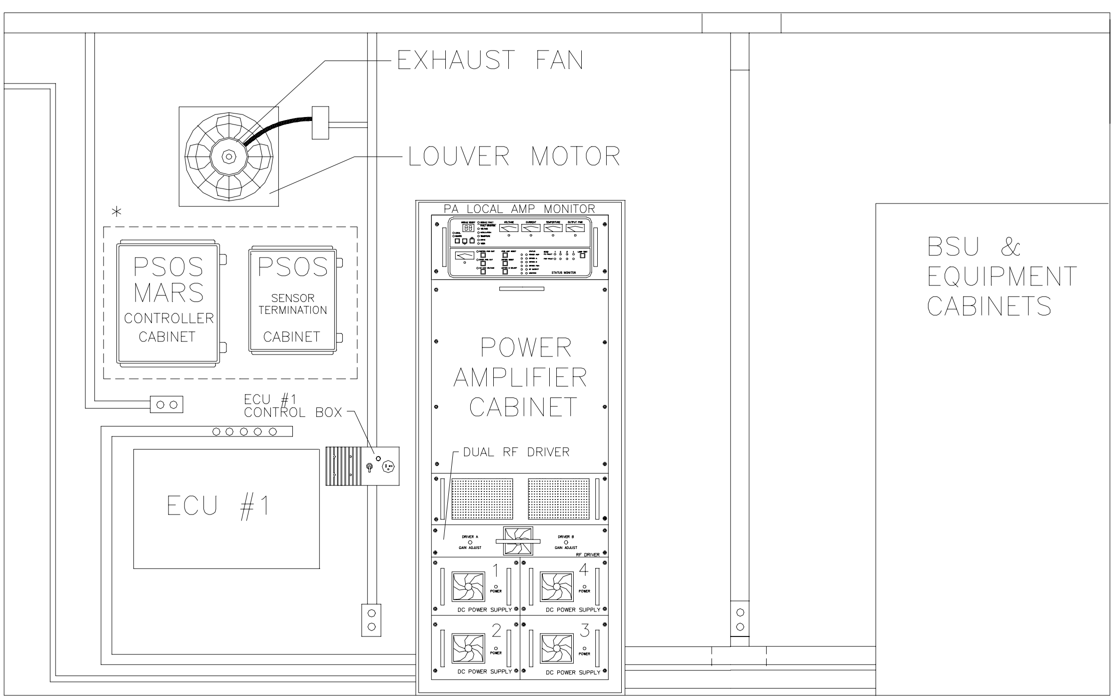


Figure 2-3 Profiler Shelter Side 2

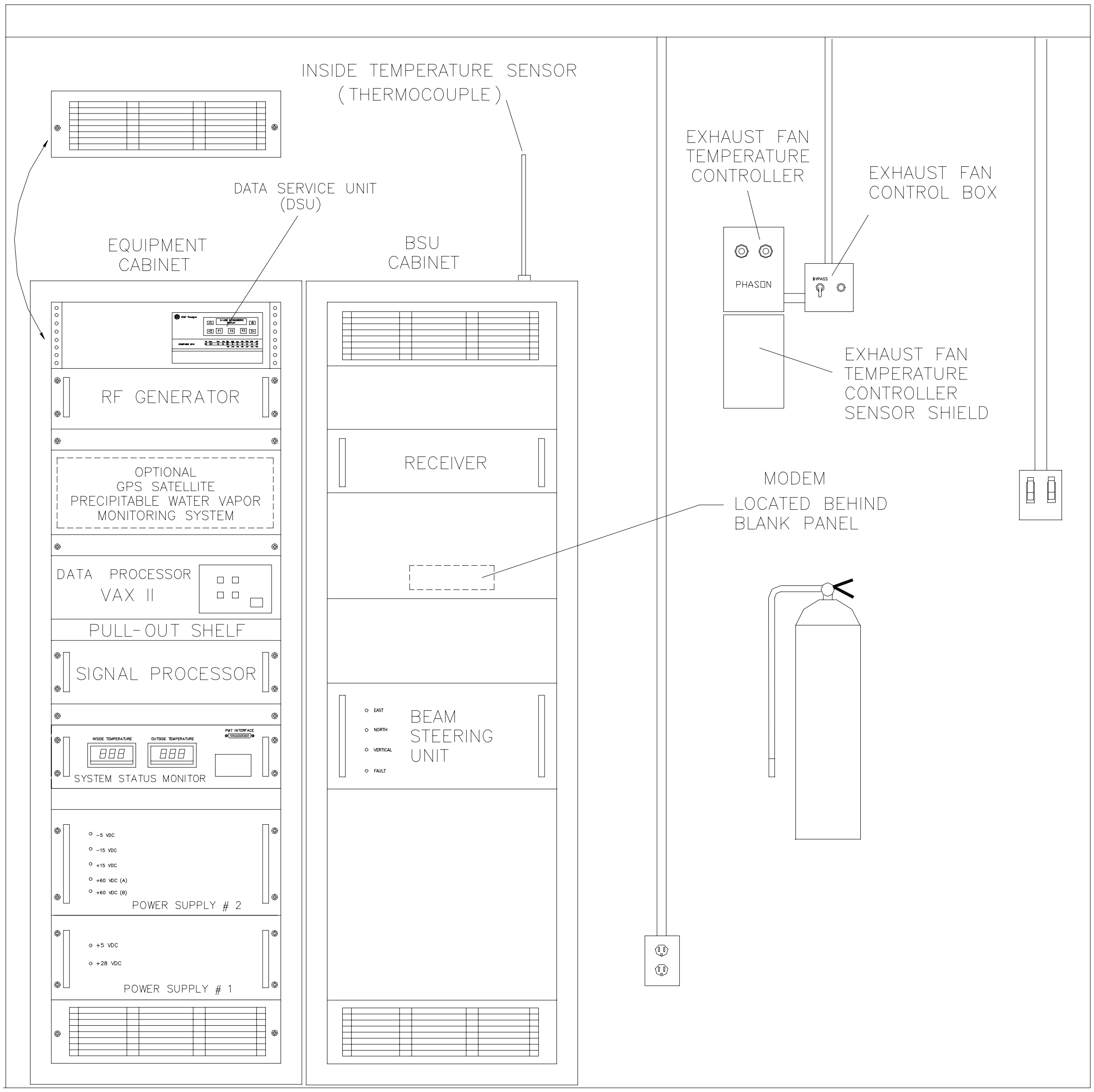


Figure 2-4 Shelter Layout Side 3

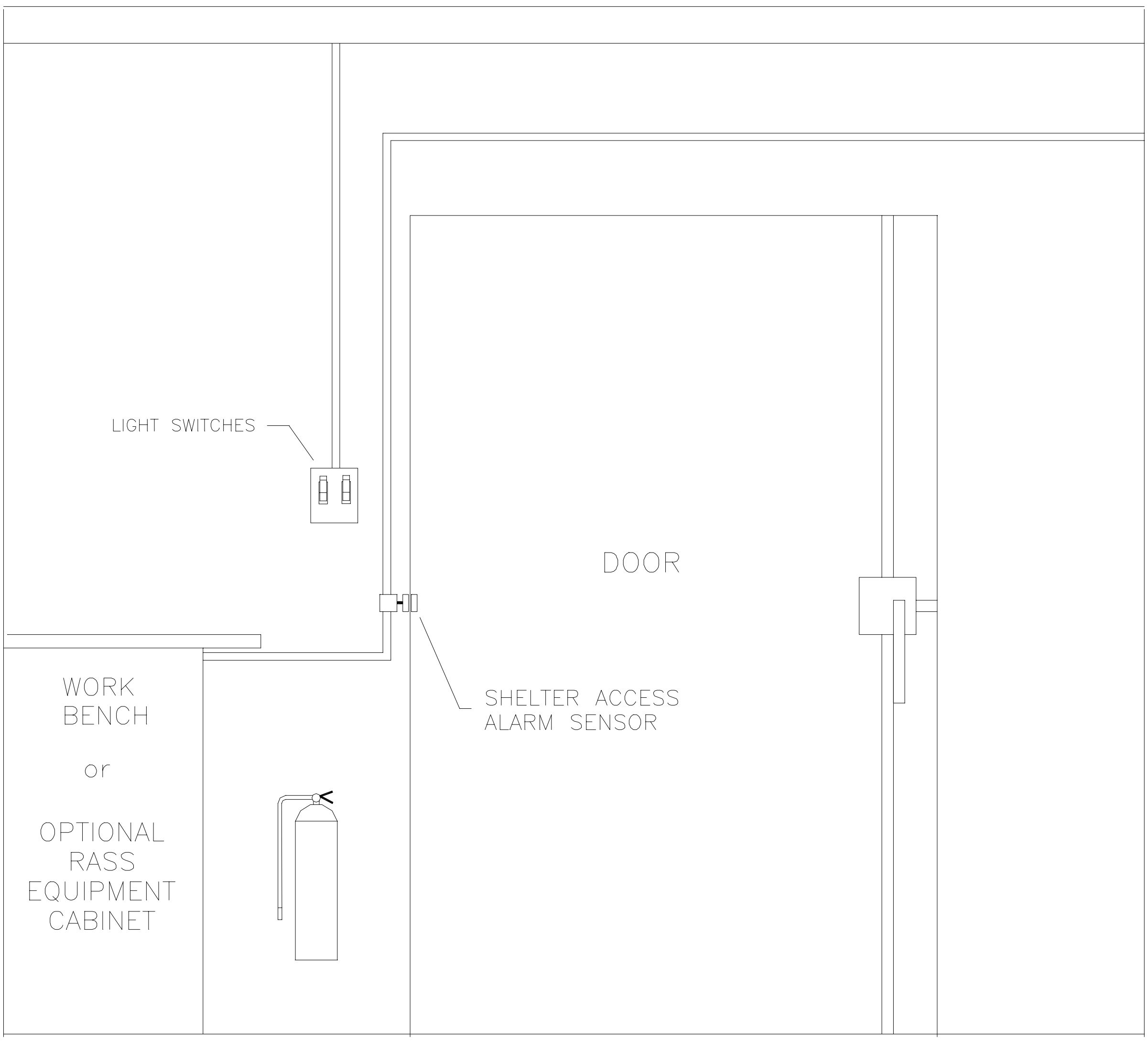


Figure 2-5 Shelter Layout Side 4

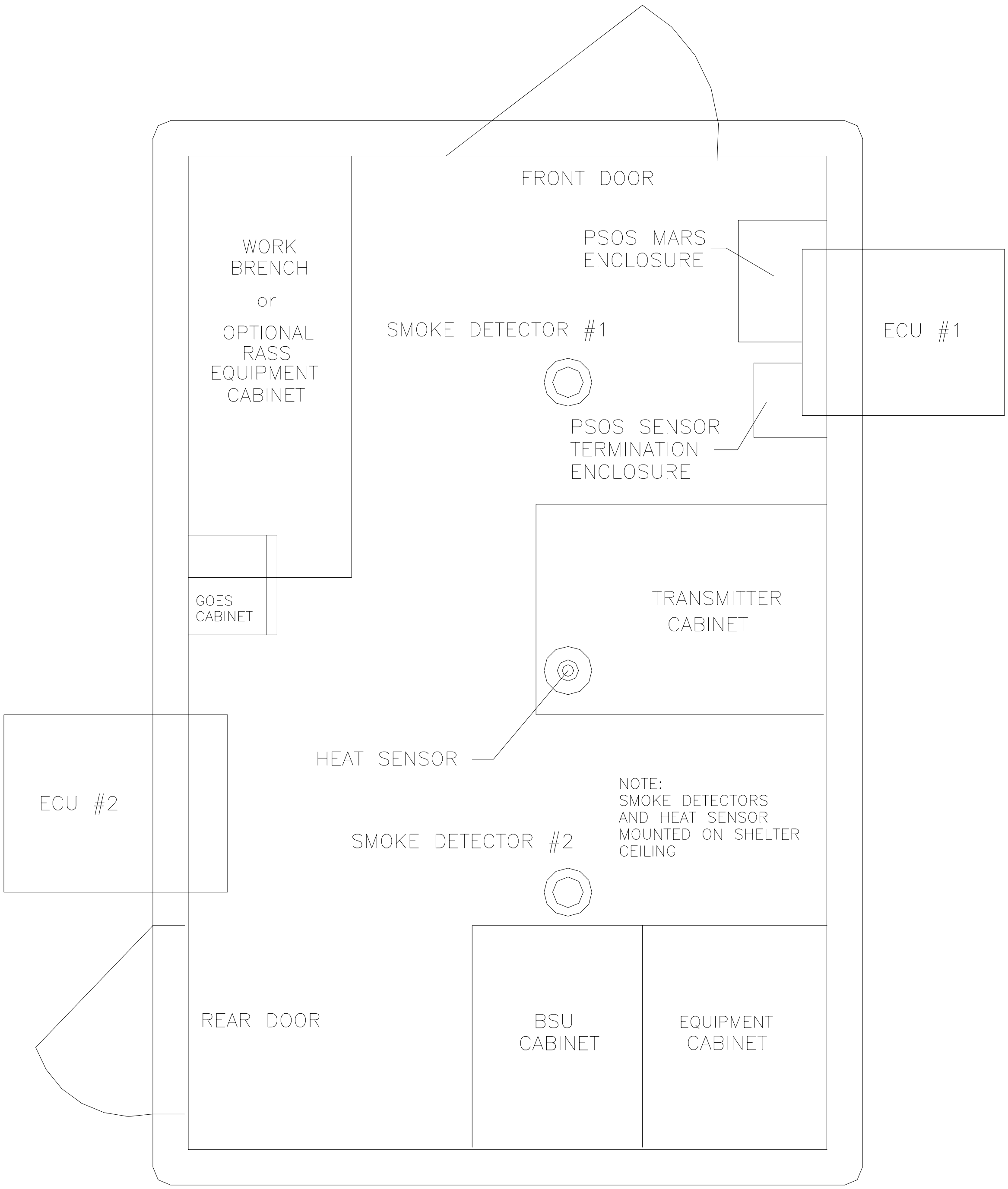


Figure 2-6 Shelter Layout Top View

2.2 Shelter AC Power

The NOAA Wind Profilers require 220 VAC (standard residential home electrical service) to operate. Power is routed to the service disconnect box and then into the Shelter Breaker Panel. Figure 2-7 and Figure 2-8 show the typical routing of AC power into the shelter and the approximate locations of installed AC surge protection devices.

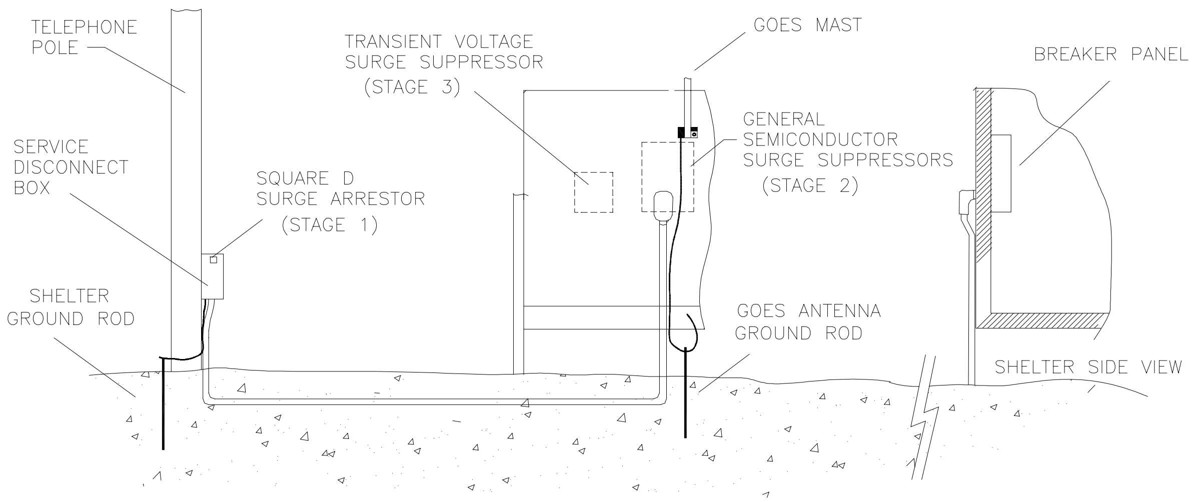


Figure 2-7 Shelter AC Power and Surge Protection

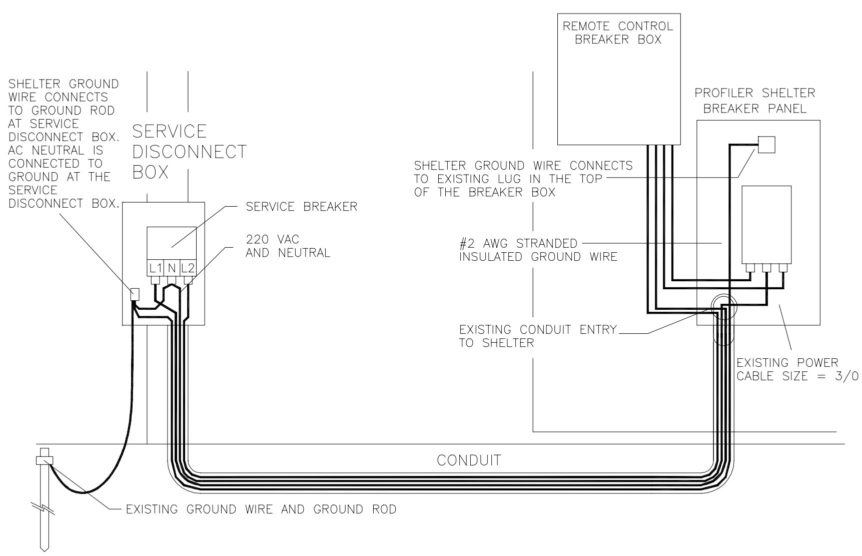


Figure 2-8 AC Power and Shelter Grounding

On the following pages, Figure 2-9 shows the Shelter Breaker Panel layout, Table 2-1 identifies the system circuit breaker allocations, and Table 2-2 identifies the circuit breaker specifications.

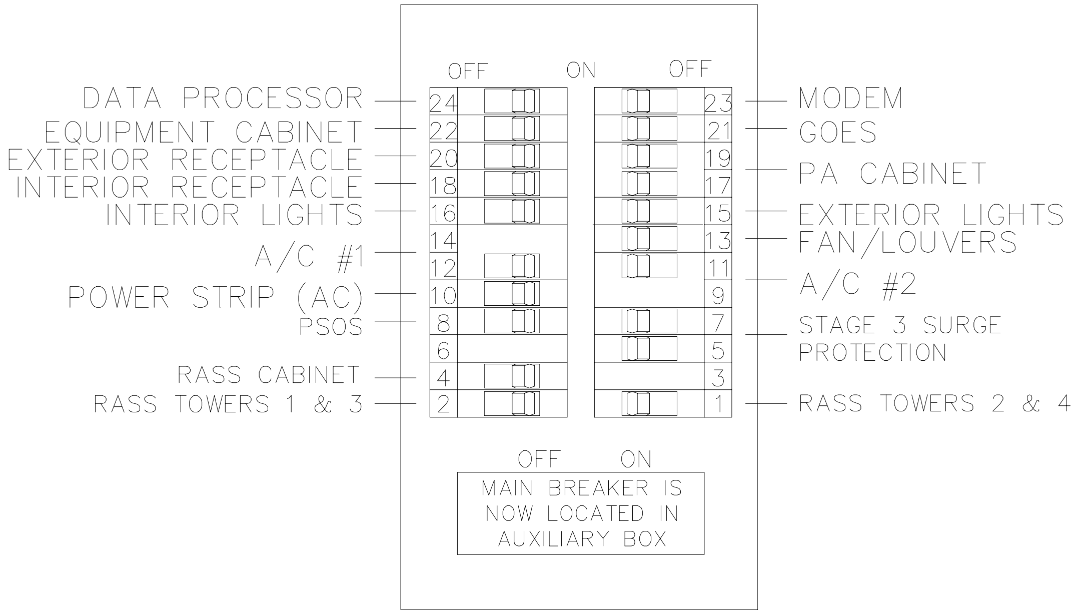


Figure 2-9 Shelter Circuit Breaker Panel Layout

Table 2-1 Circuit Breaker Directory

Breaker	Description	Description	Breaker
24	Data Processor	Modem	23
22	Equipment Cabinet	Goes Equipment	21
20	Exterior Receptacle	Power Amp Cabinet	19
18	Interior Receptacle	Power Amp Cabinet	17
16	Interior Lights	Exterior Lights	15
14	Air Conditioner #1	Fan/Louvers	13
12	Air Conditioner #1	Air Conditioner #2	11
10	Power Strip (AC)	Air Conditioner #2	9
8	PSOS	Stage 3 Surge Suppressors	7
6		Stage 3 Surge Suppressors	5
4	RASS Cabinet		3
2	RASS Towers 1 & 3	RASS Towers 2 & 4	1

Table 2-2 Circuit Breaker Specifications

Description	Slot#	Breaker Type	Square D P/N
Main Breaker	Main	200A, 2 Pole	KAL2620001380
Data Processor	24	15A, 1 Pole	Q0115
Equipment Power Supplies	22	15A, 1 Pole	Q0115
GOES Equipment	21	15A, 1 Pole	Q0115
Communication Equipment	23	15A, 1 Pole	Q0115
Power Amp Cabinet	17,19	80A, 2 Pole	Q0280
External Receptacle	20	20A, 1 Pole GFIC	Q0120GFI
Interior Receptacle Strip	8	15A, 1 Pole	Q0115
Interior Wall Receptacle	18	15A, 1 Pole	Q0115
Exterior Light	15	15A, 1 Pole	Q0115
Interior Light	16	15A, 1 Pole	Q0115
Fans/Louvers	13	15A, 1 Pole	Q0115
Air Conditioner #1	14,12	30A, 2 Pole	Q0230
Air Conditioner #2	11,9	30A, 2 Pole	Q0230
Stage 3 Surge Suppressors	7,5	20 A 2 Pole	Q0220
RASS Cabinet	4	15 A 1 Pole	Q0115
RASS Towers 1, 2, 3, 4	1,2	20 A 1 Pole	Q0120

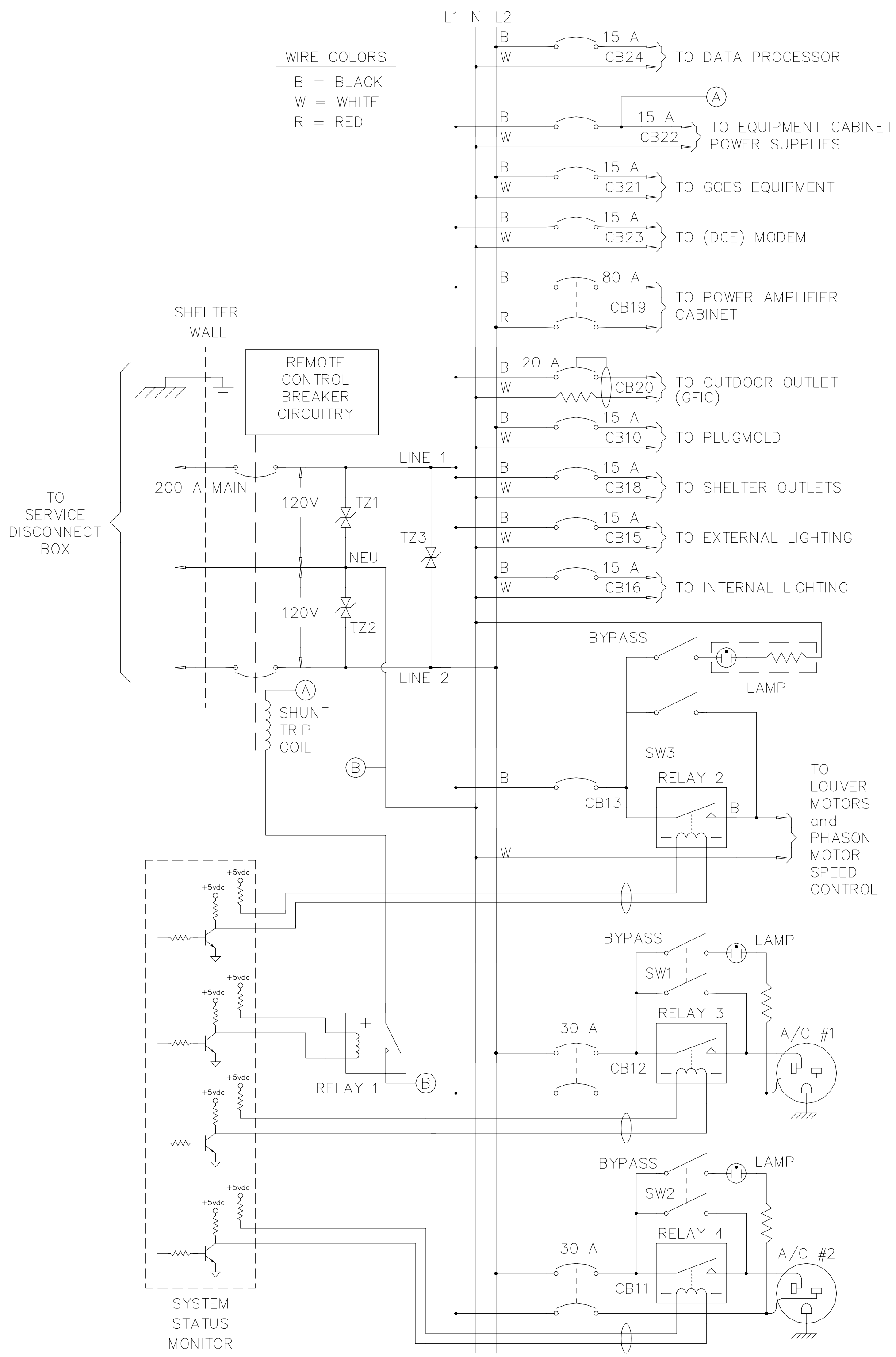


Figure 2-10 Shelter AC Power Distribution Schematic

2.2.1 Remote Control Main Breaker

Next to LRU failures, shelter main breaker trips at profilers are the second largest contributor to site down-time. In most cases, shelter breaker trips are caused by AC power fluctuations or power surges during storm passages. Although the site usually does not sustain any damage from these occurrences, the site remains down until a site visit is made (usually by NWS technician) to reset the main breaker.

To address this problem, the main breakers at all profiler sites are replaced with breakers that can be controlled remotely using a touch-tone phone. This "remote control breaker" is housed in its own enclosure mounted above the existing breaker panel as shown in Figure 2-11. A red emergency power-off button is mounted on the front cover of the enclosure. Pressing this button causes the main breaker to shut-off.

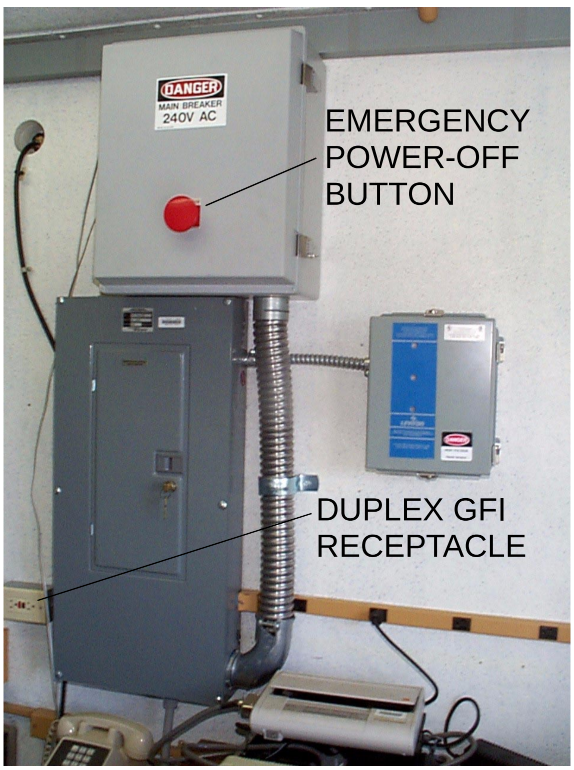


Figure 2-11 Remote Control Main Breaker

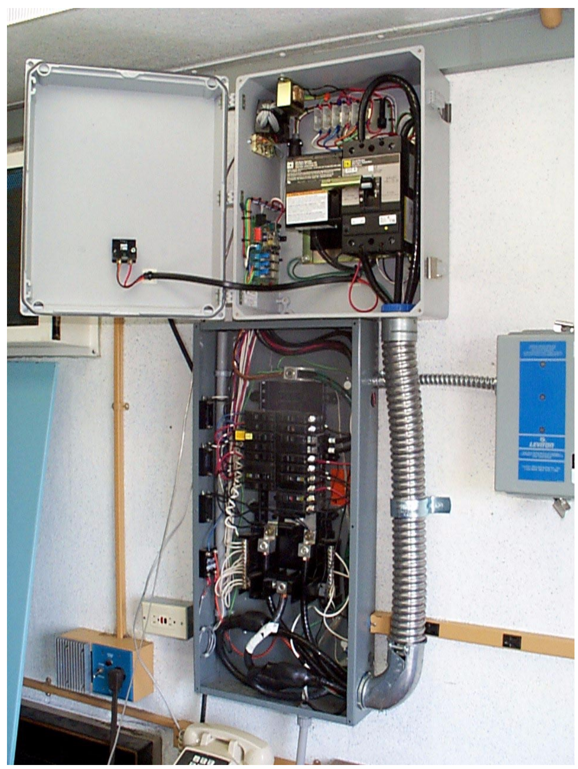


Figure 2-12 Remote Control Main Breaker Internal View

A Ground Fault Interrupt (GFI) duplex receptacle box is installed near the lower left of the breaker panel (see Figure 2-11). The GFI outlet is wired "upstream" of the main breaker and always has voltage present (even if the shelter main breaker trips). The only way to de-energize this duplex outlet is to turn off the breaker at the service disconnect box outside the shelter (see Figure 2-20).

A modular phone jack (female) located on the left side of the breaker enclosure provides the interface for the shelter voice-telephone line. The remote control breaker and the site telephone share the same phone line. Inside the box, four toroid chokes protect the phone line from fast rising transient voltages (A in Figure 2-13)

The breaker is a 200 Amp Square D Model *KAL2620001380* with an internal shunt coil (to trip the breaker) and auxiliary relay contacts that are monitored by the controller to determine if the breaker is in the closed (on) position (B in Figure 2-13).

The motor operator is a Square D Model *KAMO1* with bidirectional operation. One of two 120 VAC actuators can be energized to toggle the breaker switch to the *OFF* or *ON* position (C in Figure 2-13).

The controller is a Velleman Model *K6501* Remote Control By Telephone circuit board. The board features an integrated phone line interface and tone decoder, one input switch detector, and three 10 Amp relay outputs (D in Figure 2-13).

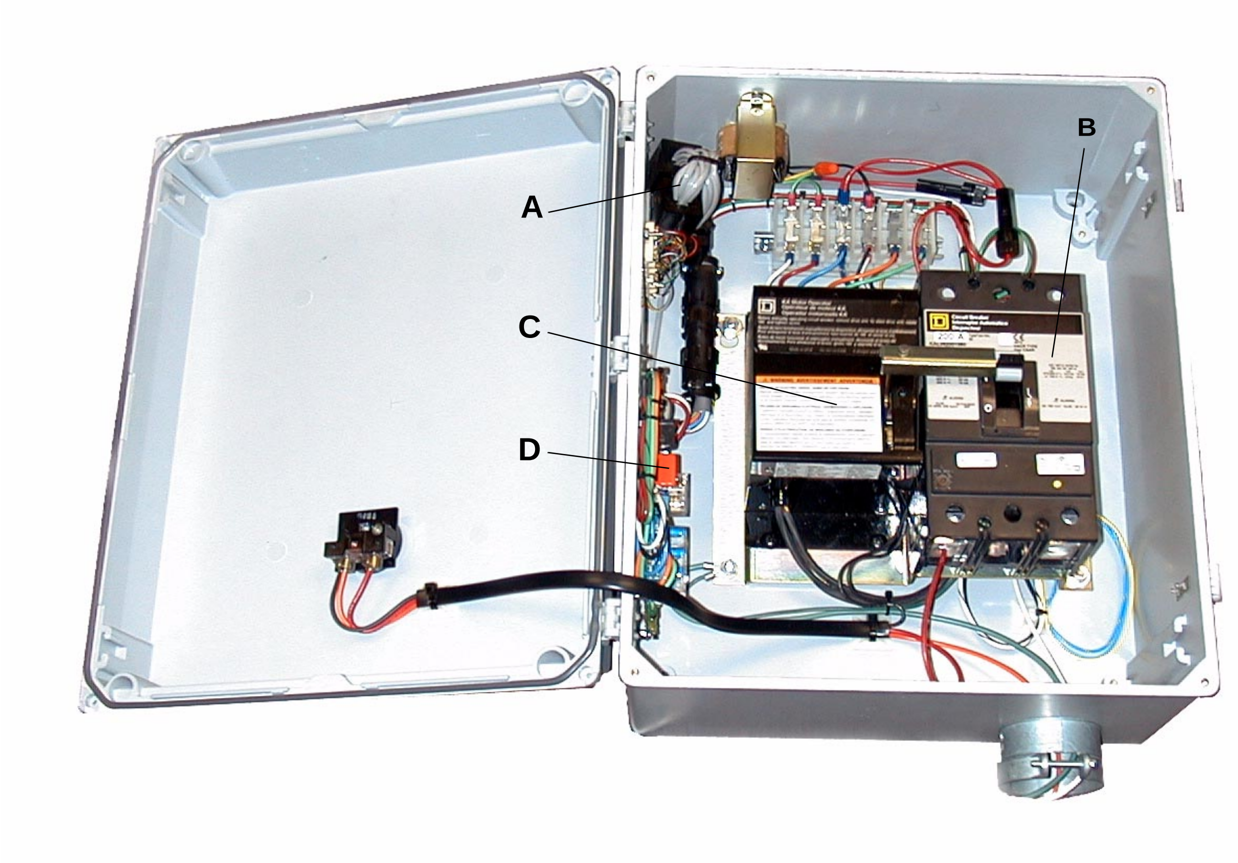


Figure 2-13 Remote Control Breaker Box Internal Components

The wiring diagram for the Remote Control Breaker is shown in Figure 2-14. The schematic diagram and component layout for the Velleman K6501 Controller are shown in Figure 2-15 and Figure 2-16 respectively. The K6501 controller wiring harness is shown in Figure 2-17

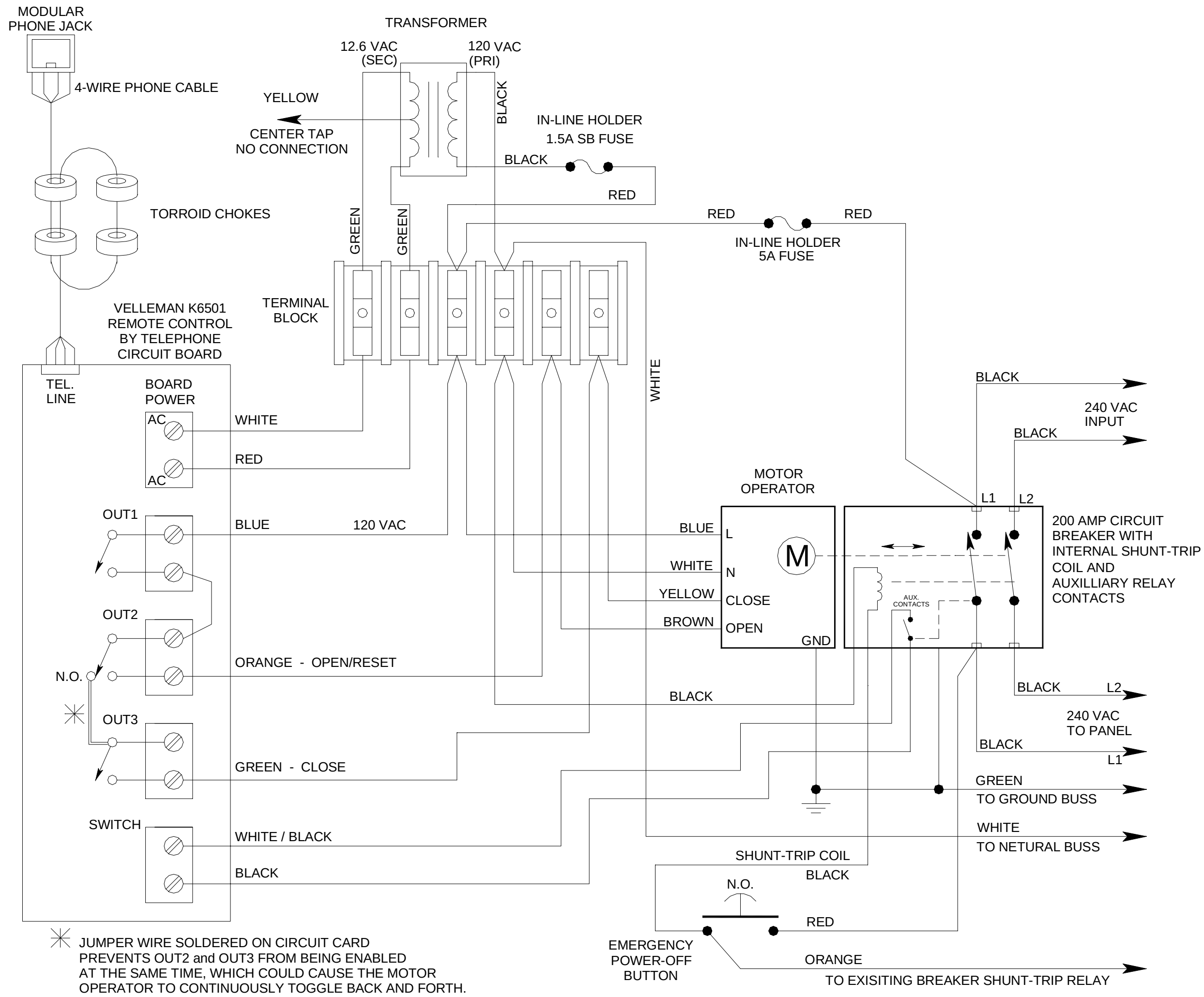


Figure 2-14 Remote Control Breaker Box Wiring Diagram

2.2.1.1 Remote Operation

2.2.1.1.1 Establishing Connection

Dial the site phone number. The controller will answer the phone on the 8th ring. The red “ON LINE” indicator LED will blink while the connection is established, and drop after several seconds after you hang up the phone.

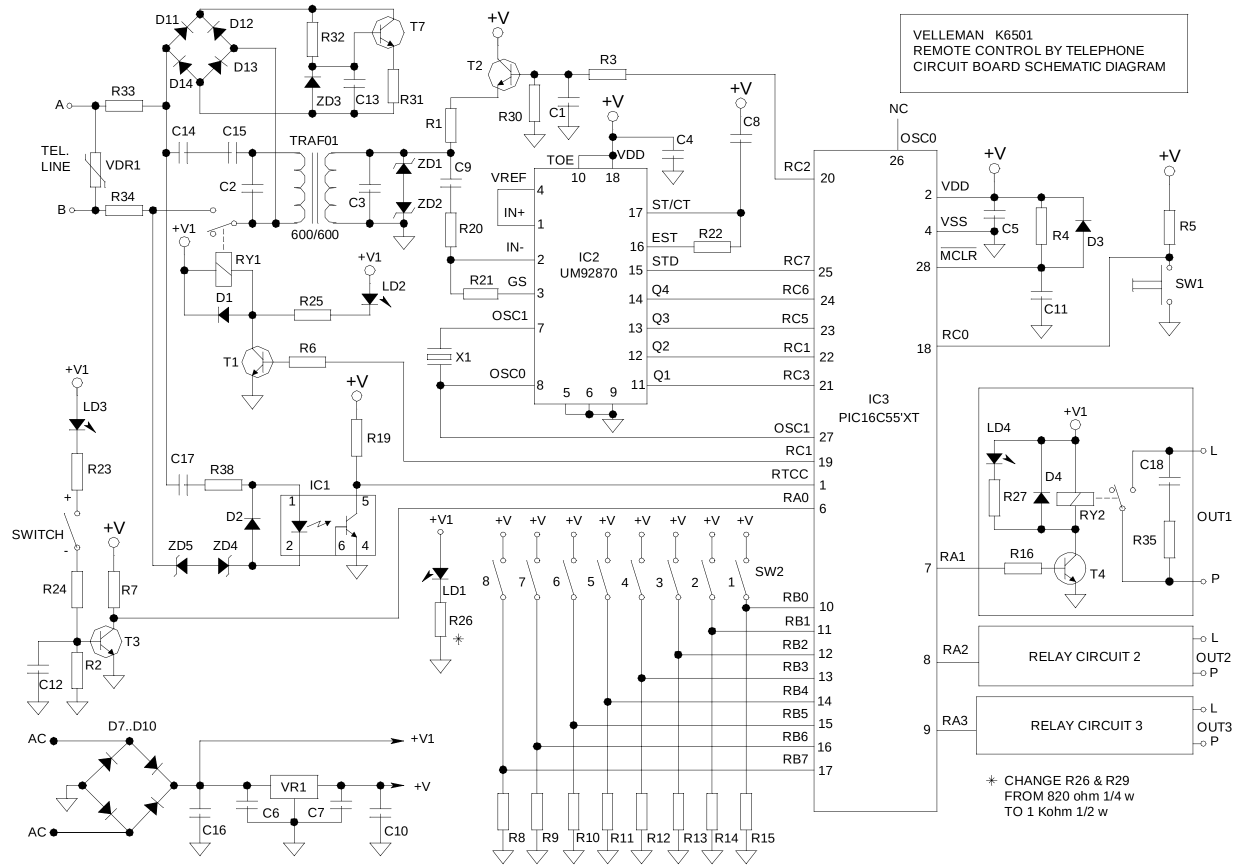


Figure 2-15 Velleman K6501 Controller Circuit Diagram

A few seconds after picking up you will hear a series of tones indicating the condition of the input and outputs. First the switch input (indicating if the main breaker is on or off), then output 1, output 2, and output 3 in that order. A double tone (one high tone and one low tone) indicates that the switch or relay is closed or *ON*, whereas a single low tone indicates the condition is open or *OFF*.

If you do not press a button within 20 seconds of the pickup, the phone connection will be automatically terminated by the controller.

If you enter a wrong 4-digit code, you will hear an alarm tone. After that you have two chances to enter a correct code. If the correct code has not been entered after three attempts, the controller will terminate the phone connection.

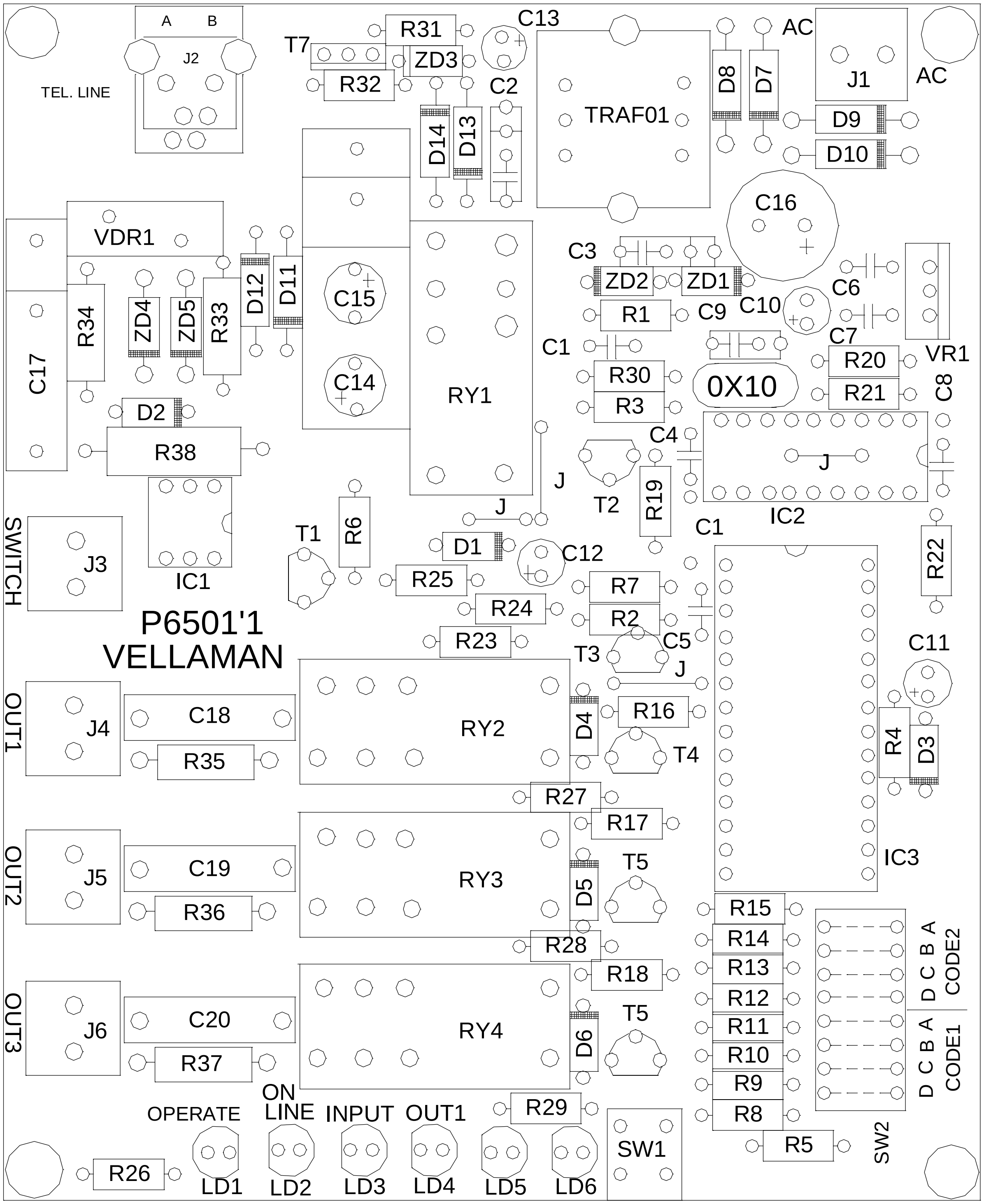


Figure 2-16 Velleman K6501 Controller Component Layout

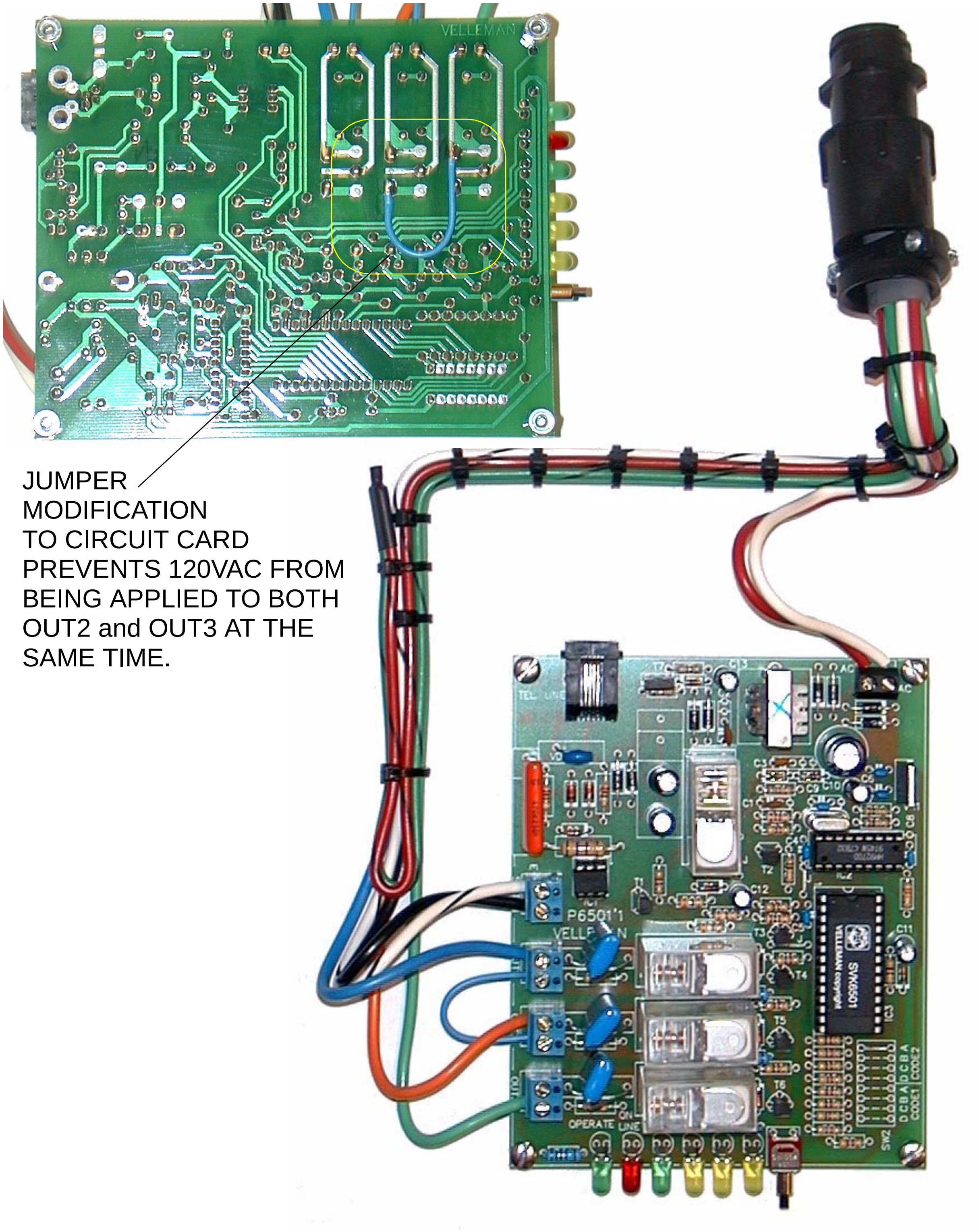


Figure 2-17 Velleman K6501 Controller Wiring Harness

2.2.1.1.2 Retrieving Information from the Input or Outputs

Using the touch-tone keypad on the phone dial “0100”. Once more you will hear the tones denoting the condition of the input and the three outputs (Input, OUT1, OUT2, and OUT3). You can repeat this procedure as often as you like.

A double tone (one high tone and one low tone) indicates that the switch or relay is closed or *ON*, whereas a single low tone indicates the condition is closed or *OFF*.

2.2.1.1.3 Switching a Particular Output ON or OFF

Enter the four digit code “n1-n2-n3-n4” the phone keypad. Where n1 is always “0”, n2 is always “1”, n3 is the number of the output 1,2, or 3, and n4 is “0” for OFF and “1” for ON.

Output	Turn OFF	Turn ON
OUT1	0110	0111
OUT2	0120	0121
OUT3	0130	0131

2.2.1.1.4 Remote Breaker Reset Procedure

1. Dial the site phone number, the controller will answer after the 8th ring.

2. Listen to the tones to determine with status of the switch and relays. Refer to Section 2.2.1.1.2 for information about interpreting the tones.

3. Press **0111** to turn-on *OUT1*.

4. Press **0121** to turn-on *OUT2* (this turns the main breaker to the *OFF* position).

5. Press **0120** to turn-off *OUT2*.

6. Press **0100** and listen to the tones to verify the status of the switch and relays. Make sure the switch is *OFF*, *OUT1* is ON, *OUT2* is *OFF*, and *OUT3* is *OFF*. Refer to Section 2.2.1.1.2 for information about interpreting the tones.

***** NOTE *****

***OUT3* will not function if *OUT2* is Active (ON). This prevents a condition that could cause the Motor Operator to continuously toggle the Main Breaker Switch OFF and ON!**

7. Press **0131** to turn-on *OUT3* (this turns the main breaker to the ON position).

8. Press **0130** to turn-off *OUT3*.

9. Press **0110** to turn-off *OUT1*.

10. Press **0100** and listen to the tones to verify the status of the switch and relays. Make sure the switch is *ON*, and *OUT1 - OUT3* are all *OFF*. Refer to Section 2.2.1.1.2 for information about interpreting the tones.

11. Hang-up phone.

2.2.1.2 Local Operation

The three outputs may be turned on or off manually be means of the push button. If the switch or outputs are on (closed) the corresponding LED indicator will illuminate (see Figure 2-18).

- Press the push button one to turn output 1 on or off.
- Press the push button twice without pause to turn output 2 on or off.
- Press the push button three times without pause to turn output 3 on or off.

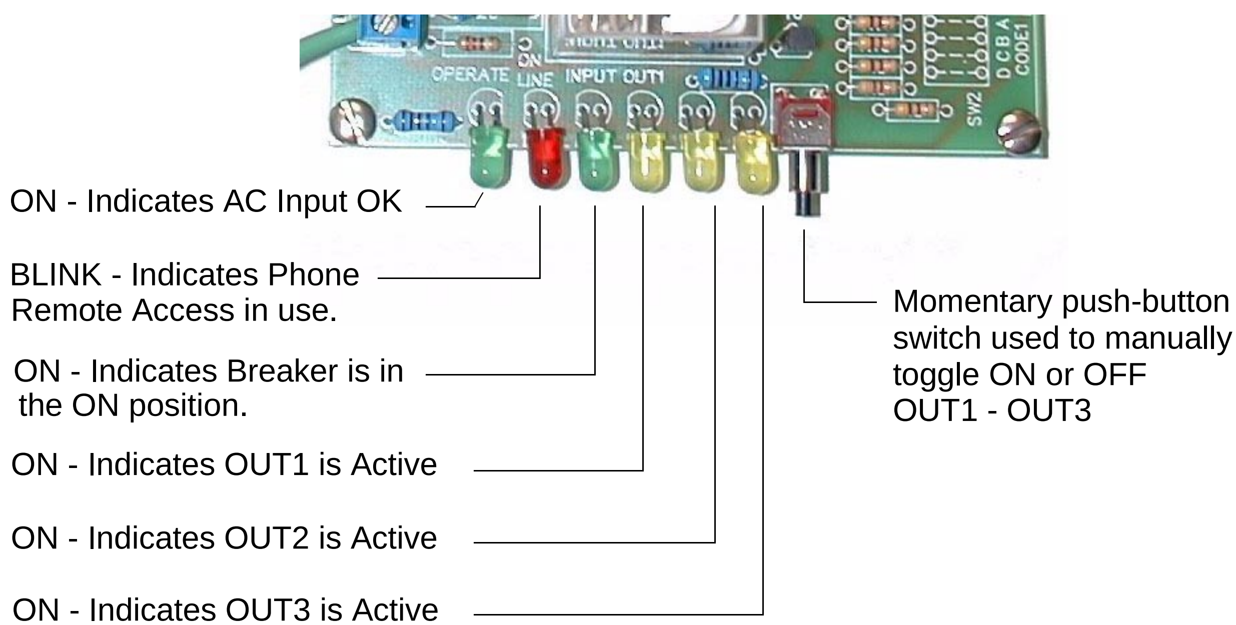


Figure 2-18 Velleman K6501 Controller LED Indicators and Switch Locations

2.2.1.2.1 Local Breaker Reset Procedure

If the main breaker trips, the switch will be midway between on and off. To reset the main breaker the switch must to turned off first before it can be switched to the on position. Avoid resetting the main breaker switch by hand (forcing the motor operator). Instead, use the following procedure to allow the motor to reset the main breaker.

The breaker must be reset by toggling the relays in a specific order. This is done by using the momentary switch at the end of the row of L.E.D.'s on the circuit card mounted at the bottom left hand side of the box (see Figure 2-18). The ON/OFF status of the breaker and relays are indicated by the LEDs labeled *OPERATE, ON LINE,INPUT, OUT1, OUT2, and OUT3* from left to right.

The 220VAC supply must be present at the box to reset breaker (***OPERATE*** LED must be illuminated).

1. Push the plunger once. This will activate ***OUT1***, and light the fourth (yellow) LED. (*OUT1* must be ON to use *OUT2* or *OUT3*.)

2. Push the plunger twice without pause. This will activate ***OUT2***, light the fifth (yellow) LED, and switch the breaker to the "OFF" position.

3. Push the plunger twice without pause. This will deactivate ***OUT2***, turn-off the fifth (yellow) LED. It is important to turn off *OUT2* before proceeding to the next step.

> ***** NOTE *****
>
> ***OUT3*** **will not function if** ***OUT2*** **is Active (ON). This prevents a condition that could cause the Motor Operator to continuously toggle the Main Breaker Switch OFF and ON!**

4. Push the plunger three times without pause. This will activate ***OUT3***, turn on the sixth (yellow) LED, and switch the breaker to the "ON" position.

5. Push the plunger three times without pause. This will deactivate ***OUT3***, and turn off the sixth (yellow) LED.

6. Push the plunger once. This will deactivate ***OUT1***, turn off the fourth LED, and return the box to its normal state.

7. **After the breaker has been reset, make sure that OUT1, OUT2, and OUT3 LED indicators are all OFF!**

2.3 Standard Power Down Sequence

It is essential to power down the system in the proper sequence to protect the radar receiver from damage. Always turn off the power to the Transmitter Cabinet (a.k.a. Power Amplifier Cabinet) before any other cabinet is powered down.

Turning off the power in the Equipment Cabinet or BSU Cabinet before the PA Cabinet can result in a timing error that will allow the Transmit/Receive (T/R) Switch to send high-power RF energy into the input stage of the Receiver, effectively destroying its front end.

The following standard power-down sequence should be used to replace any LRU in the Transmitter, BSU, or Equipment Cabinets. If any LRU is replaced in any one of these cabinets, all three cabinets must be powered down as follows:

1. Locate the circuit breaker panel on the wall next to GOES Cabinet and the work bench.

2. Turn off the circuit breakers in the following sequence:

   a. #17/#19 - PA Cabinet
   b. #22 - Equipment/BSU Cabinet
   c. #24 - Data Processor.

Refer to Figure 2-9 for the layout of the breaker box.

2.4 Standard Power Up Sequence

1. Turn on the AC breaker switches in the following sequence:

   a. #24 - Data Processor
   b. #22 - Equipment/BSU Cabinet
   c. #17/#19 - PA Cabinet.

2. When the radar is powered up, it is sometimes necessary to reset the Power Amplifier RF driver to "Driver A". The RF Driver can only be reset if the RF input LED is red (indicating the system is not transmitting). The driver can be reset immediately after setting the PA Cabinet Breaker (Breakers #17/#19) while the Data Processor software is booting.

3. To reset the RF Driver, place the PA local status monitor in local mode. Press the "DRIVER RESET" button. The "Driver A" LED should turn green and the "Driver B" LED should turn off. Push the "PWR AMP RESET" button and then put the PA Local Status Monitor back into remote mode.

2.4.1 Profiler Boot Sequence

Once AC power is applied to the Data Processor (DP), Equipment Cabinet, and Transmitter Cabinet, the profiler progresses through a standard boot-up sequence. This sequence of events can be observed to verify or troubleshoot successful startup of the profiler system. The boot-up sequence of events is defined as follows:

1. The DP runs through its countdown sequence. During each stage of the countdown sequence the RUN LED on the DP front panel will blink. When the DP successfully completes its boot-up sequence the RUN LED will illuminate continuously. Simultaneous to the RUN LED blinking, a single character alphanumeric display located on the rear panel of the DP displays hexadecimal digits signifying the current stage of the countdown sequence. When the alphanumeric display reaches zero, the DP has completed boot-up successfully. If the DP fails to complete this boot-up sequence, it usually indicates an internal problem with the DP. This type of problem can usually be remedied by re-seating the cards in the DP card cage (see Section 4.4).

2. Immediately after the DP completes its boot sequence, the beam indicator LED located on the front panel of the Beam Steering Unit switches from the Vertical beam to the East beam. If the BSU fails to switch to the East Beam, it indicates a possible problem with the Signal Processor (SP).

3. After the BSU switches to the East Beam, the DP polls the System Status Monitor (SSM) for the site specific information stored on the SSM EEPROMs. Failure to acquire the site specific information from the SSM will cause the DP to revert to Initial Setup mode. This type of behavior may indicate a disconnected cable between DP port B1 and SSM port J2, or some other RS-232 related hardware problem.

4. If the DP communicates successfully with the SSM, the DP attempts to upload operating parameters to the GOES assembly. When the DP is communicating with the GOES assembly the Active LED on the GOES Master Control Module (MCM) front panel illuminates. If the Active LED on the GOES assembly does not illuminate, there may be a cabling or hardware problem with either DP port B4 or the GOES MCM.

5. After the DP has successfully initialized the GOES or declared the GOES assembly inoperative, the DP enables responses to login requests from the Profiler Maintenance Terminal (PMT). If the DP is unable to successfully program the GOES MCM, PMT login requests are ignored until the DP either; successfully programs the GOES MCM, or declares the GOES MCM inoperative. This scenario can cause PMT log in attempts to be ignored for up to 15 minutes. This

type of failure can be caused by RS-232 hardware failures in the DP and/or GOES MCM, requiring replacement of one or both of these components.

2.5 Voltage Suppression Devices

As indicated in Figure 2-19, Voltage Suppressor Schematic Diagram, the AC power lines feeding the profiler shelter have three stages of voltage surge suppression. The first stage is located outside of the shelter in the service disconnect box, the second is located inside the main breaker panel, and the third is located in a box next to the main breaker panel. Refer to Figure 2-7 for the location of these devices.

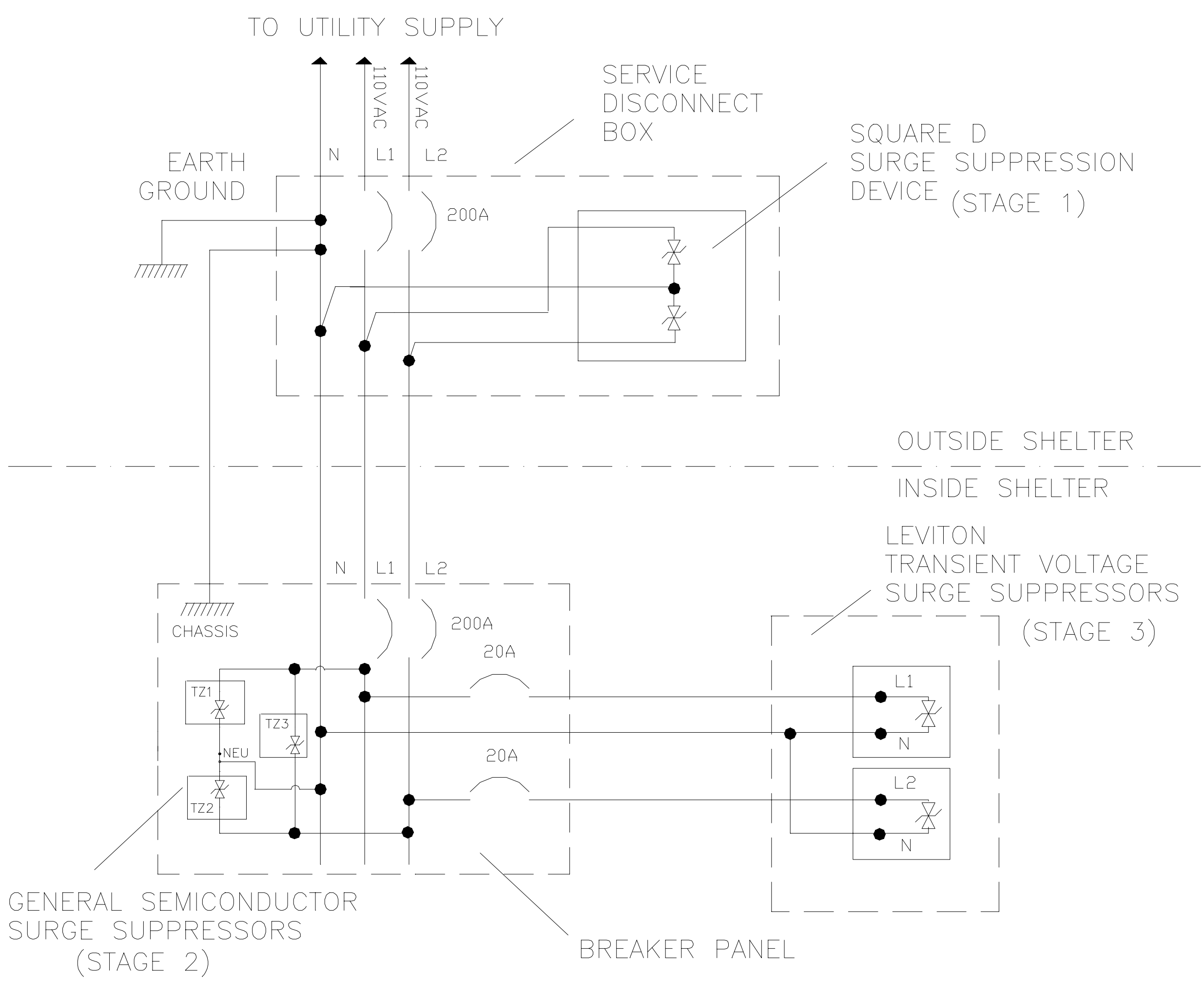


Figure 2-19 Voltage Suppression Schematic Diagram

2.5.1 Stage 1 Voltage Suppressor Replacement Procedure

The Power Line Surge Suppressor is located outside of the shelter and attached to the side of the service disconnect box. The device is a Square D P/N SP1175 or equivalent, and provides common mode protection.

***** CAUTION *****

When replacing the surge suppression devices, use extreme caution within the service disconnect box. There is no way to completely shut off power to this box.

LETHAL VOLTAGES WILL BE PRESENT ON THE SOURCE SIDE OF THE BREAKER!

1. Locate the service disconnect box and turn off the main breaker (see Figure 2-20).

2. Open the service disconnect box and locate the surge suppressor on the side.

3. Disconnect the three wires between the two-phase power and the suppressor unit.

4. Remove the suppressor unit by removing the nut on the inside service disconnect housing.

5. Replace with a new suppressor unit and connect the wires between the new unit and the two-phase power and ground.

6. Replace the housing cover and turn on the main breaker.

Figure 2-20 Typical Profiler Site AC Power Service Disconnect

2.5.2 Stage 2 Voltage Suppressor Replacement Procedure

Stage 2 voltage suppressors were provided as original equipment by the manufacturer when the radar was installed and consist of three units. Two units provide common-mode protection for the 110 VAC lines and the third unit provides differential-mode protection across the two 110 VAC lines. These suppressors are located inside the breaker panel of shelter (see Figure 2-21). Replacement of Stage 2 voltage suppression devices requires removing the main breaker panel cover.

Because the lights in the shelter will be off when the Main Breaker is thrown, a flashlight or other means of portable lighting will be useful for this procedure. The shelter doors can also be propped open to allow light into the shelter.

***** CAUTION *****

The MAIN AC BREAKER and the SERVICE DISCONNECT BREAKER must be *OFF* for this procedure.

1. Turn off the breaker at the service disconnect box located outside the shelter and the main breaker inside the shelter.
2. Remove the mounting screws at the front of the circuit breaker panel, and remove the circuit breaker panel cover.
3. Locate the voltage suppression devices on the inner left side of the breaker box. Refer to Figure 2-21 for the internal layout of the panel. Trace the wires to their points of connection and disconnect them. The replacement voltage suppression devices will not have wires soldered to them. The wires to the old voltage suppressors must be disconnected and resoldered to the replacement devices. The wire colors and their locations should be noted to properly reconnect the replacement units.
4. Remove the faulty suppressor(s) from the breaker panel wall.
5. Restore AC power to the shelter to permit use of a soldering gun.
6. Transfer the wires to the new devices.
7. Turn off the shelter power at the main breaker and at the service disconnect.
8. Install the new suppressors and reconnect the wires.
9. Replace the circuit breaker panel cover.
10. Turn on the service disconnect box breaker and the shelter main breaker.

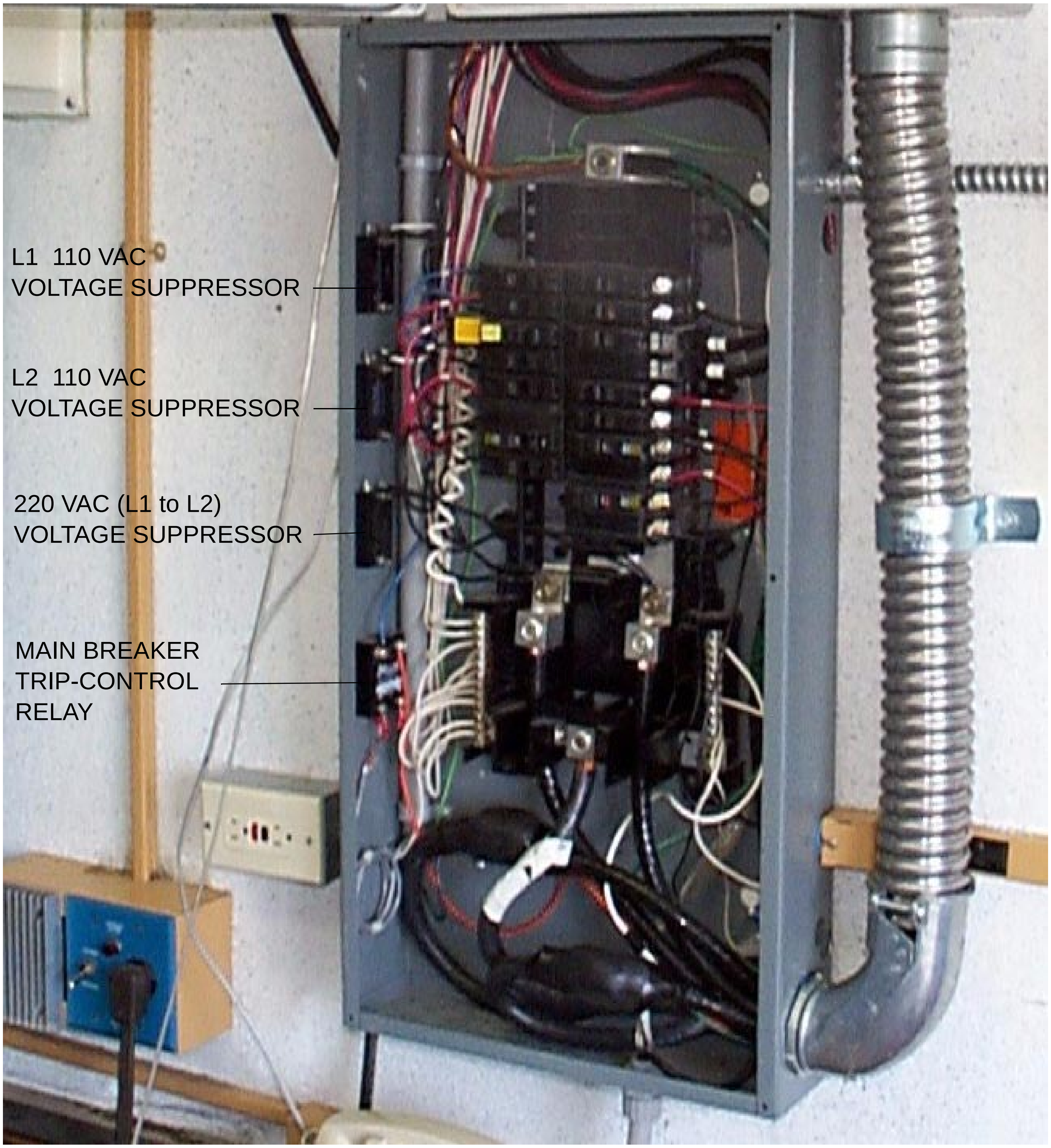


Figure 2-21 Shelter Circuit Breaker Panel Internal Layout

2.5.3 Stage 3 Voltage Suppressor Replacement Procedure

Stage 3 Transient Voltage Surge Suppressors (TVSS) are located in the shelter near the main breaker panel. These devices are housed in a LEVITON TVSS enclosure with a hinged lid (see Figure 2-22). Inside the enclosure is a panel with four receptacles for the TVSS modules. The top two receptacles are wired to the AC line power and the bottom two are slots for spare modules. On the face of each TVSS module is a green LED that indicates the module's functional state. If the LED is not illuminated when the module is plugged in, the module is probably damaged.

1. Locate the LEVITON TVSS unit on the wall of the shelter and open the lid by loosening the fastening screws.
2. Inspect the panel for failed modules by observing the individual module LED status light indicators.
3. Turn off the appropriate circuit breaker. (The breaker number may vary from site to site).
4. Carefully remove the failed module by pulling it straight out of the board.

***** CAUTION *****

TO AVOID CAPACITIVE SHOCK, discharge the module by placing the blade of an insulated screwdriver or similar instrument across the two metal posts of the module.

5. Check for continuity between the two metal posts using an Ohm meter. If the resistance is less than 1 kilo Ohm, the module has failed.
6. Replace the failed module with a new module identical to the one removed.
7. Close the lid of the enclosure, fasten the retaining screws, and reset the appropriate breaker. Verify that the LED indicator in the replaced module is illuminated.

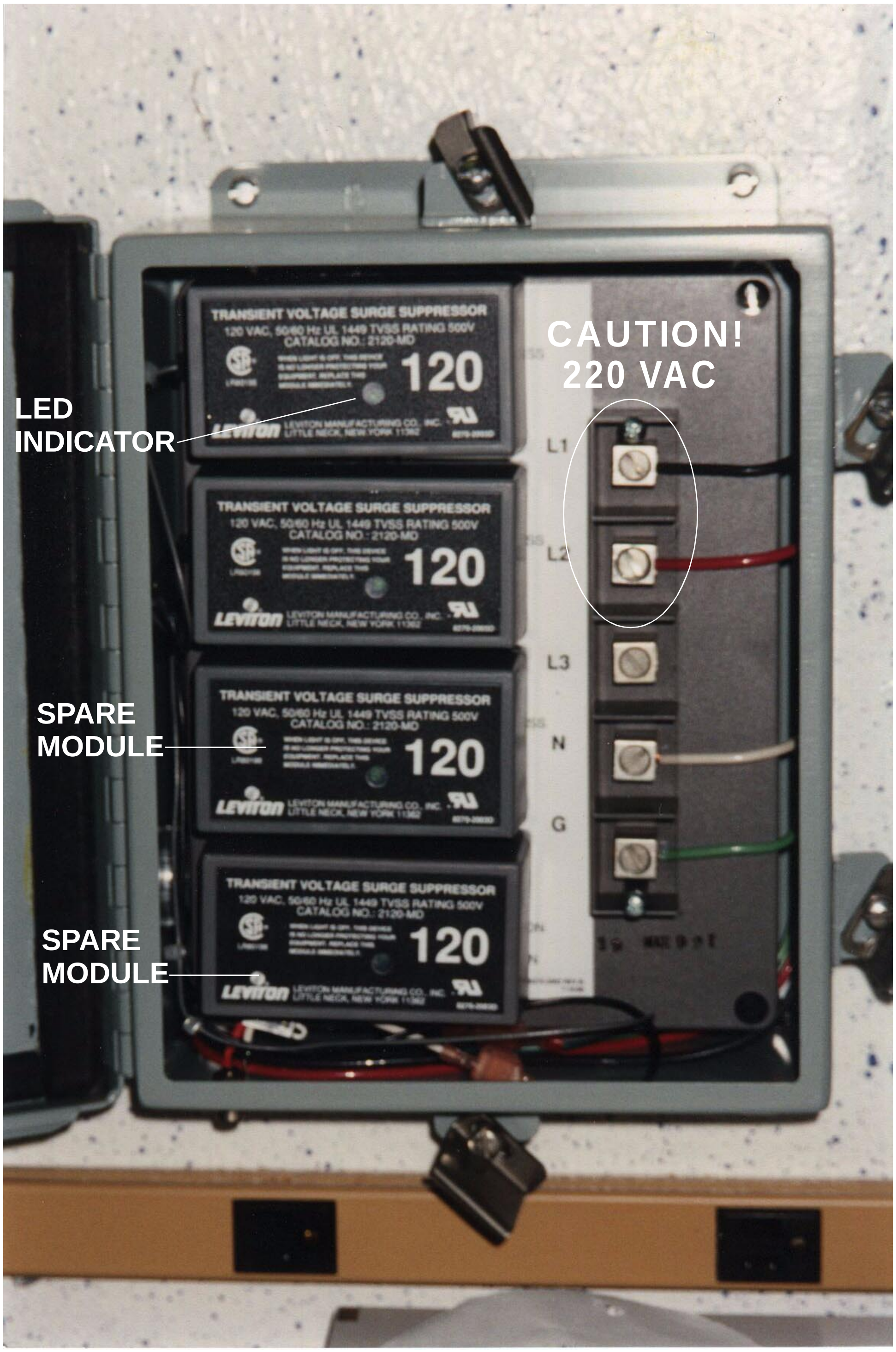


Figure 2-22 LEVITON Surge Suppressor Enclosure

3 Environmental Monitoring and Control

The environment of the NOAA Wind Profiler Shelter Assembly is monitored and controlled by the Status Monitor Assembly, also referred to as the System Status Monitor (SSM). Conditions monitored by the SSM include inside and outside temperature, smoke, flooding, access to the equipment shelter, and access to the antenna field. The SSM monitors nine environmental sensors and four transmitter- related sensors, and commands four solid-state relays that control the air conditioners (ECUs), exhaust fans and louvers, and site shut-down. Figure 3-1 depicts the SSM environmental interfaces.

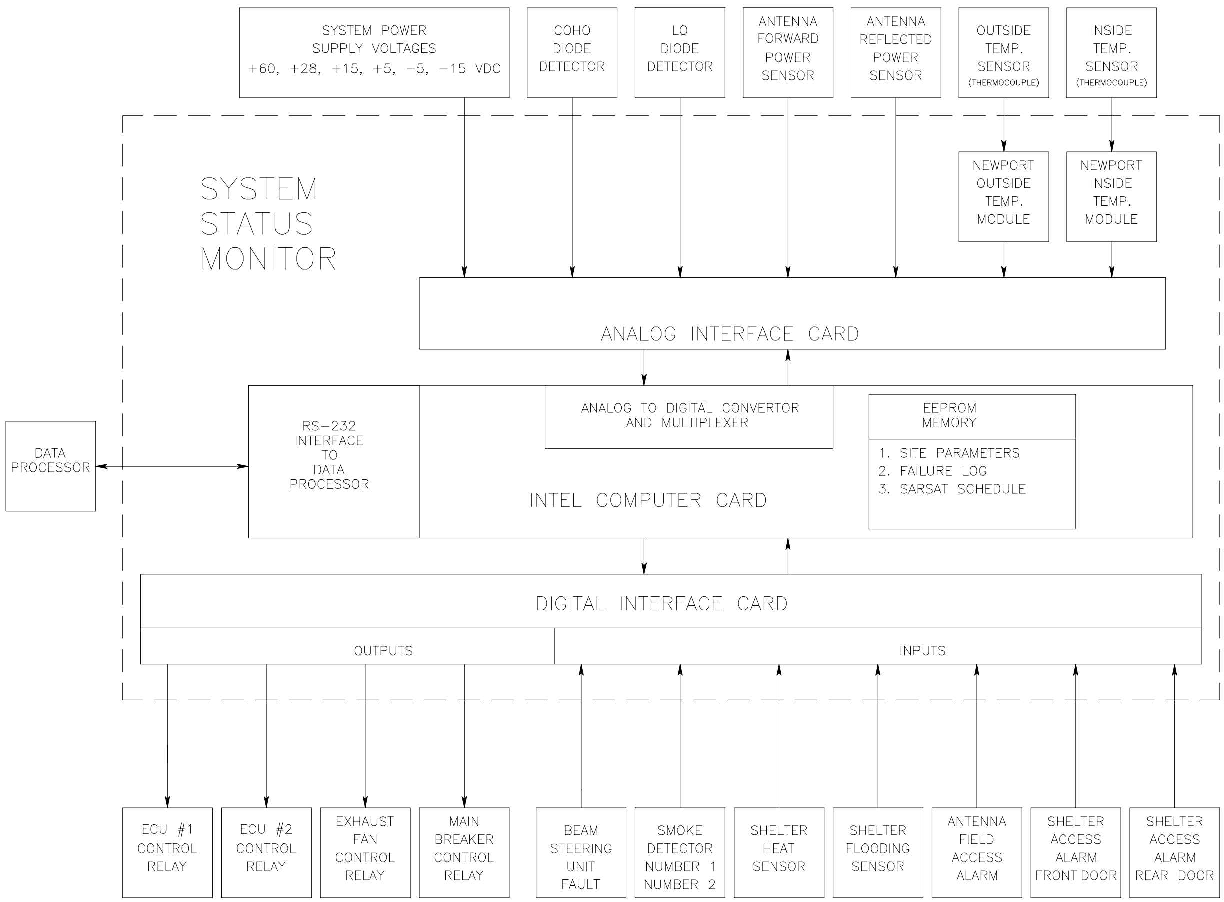


Figure 3-1 System Status Monitor Environmental Interfaces

3.1 Temperature Monitoring and Control

The SSM uses three sensors to monitor shelter temperature: the Inside Temperature Sensor (or Inside Thermocouple Assembly) located at the top of the BSU cabinet (see Figure 2-3 in the previous Section); the Outside Temperature Sensor (or Outside Thermocouple Assembly) located outside the shelter behind the equipment rack (in the antenna field); and the Inside Heat Sensor (or Over-Temperature Sensor) located at the center of the shelter ceiling (see Figure 2-6).

A temperature control algorithm, running on firmware in the SSM Intel 186/03A computer card, monitors temperature both inside and outside the shelter. A flow diagram for this algorithm is presented in Figure 3-2. The algorithm engages the shelter's environmental control system to keep the inside temperature between 70 and 80 F (21 - 27 C). The temperature control algorithm functions as defined in Table 3-1.

Table 3-1 Shelter Temperature Control Algorithm

Inside vs. Outside Temperature	SSM Control Action
Outside Temp. (Irrelevant) Inside Temp. < 60 F (15 C)	No matter what the outside temperature is, if the inside shelter temperature is below 60^{o}F SSM shuts off both ECUs and the exhaust fan.
Outside Temp. < 60 F (15 C) Inside Temp. > 70 F (21 C)	The SSM uses the exhaust fan to pull hot air out of the shelter. A vent at the opposite side of the shelter opens to allow outside air to enter the shelter. Once the inside temperature falls below 70 F (21 C), the SSM shuts off the exhaust fan and closes the vent.
Outside Temp. > 60 F (15 C) Inside Temp. > 70 F (21 C)	The SSM uses the ECUs to cool the shelter. Once each hour, the SSM will switch the cooling load from one AC unit to the other to equalize use of the two units.
Outside Temp. > 60 F (15 C) Inside Temp. >80 <90 F (27-32 C)	The SSM will engage both ECUs until the inside temperature falls blow 80 F (27 C).
Outside Temp. > 60 F (15 C) Inside Temp. >= 100 F (37.5 C)	If the inside temperature reaches 100 F (37.5 C), the SSM will turn on both ECUs and the exhaust fan. If no reduction in temperature is measured after 6 minutes, the SSM will shut down the profiler by tripping the Main Breaker using the Main Breaker Trip Control Relay (see Figure 2-10).

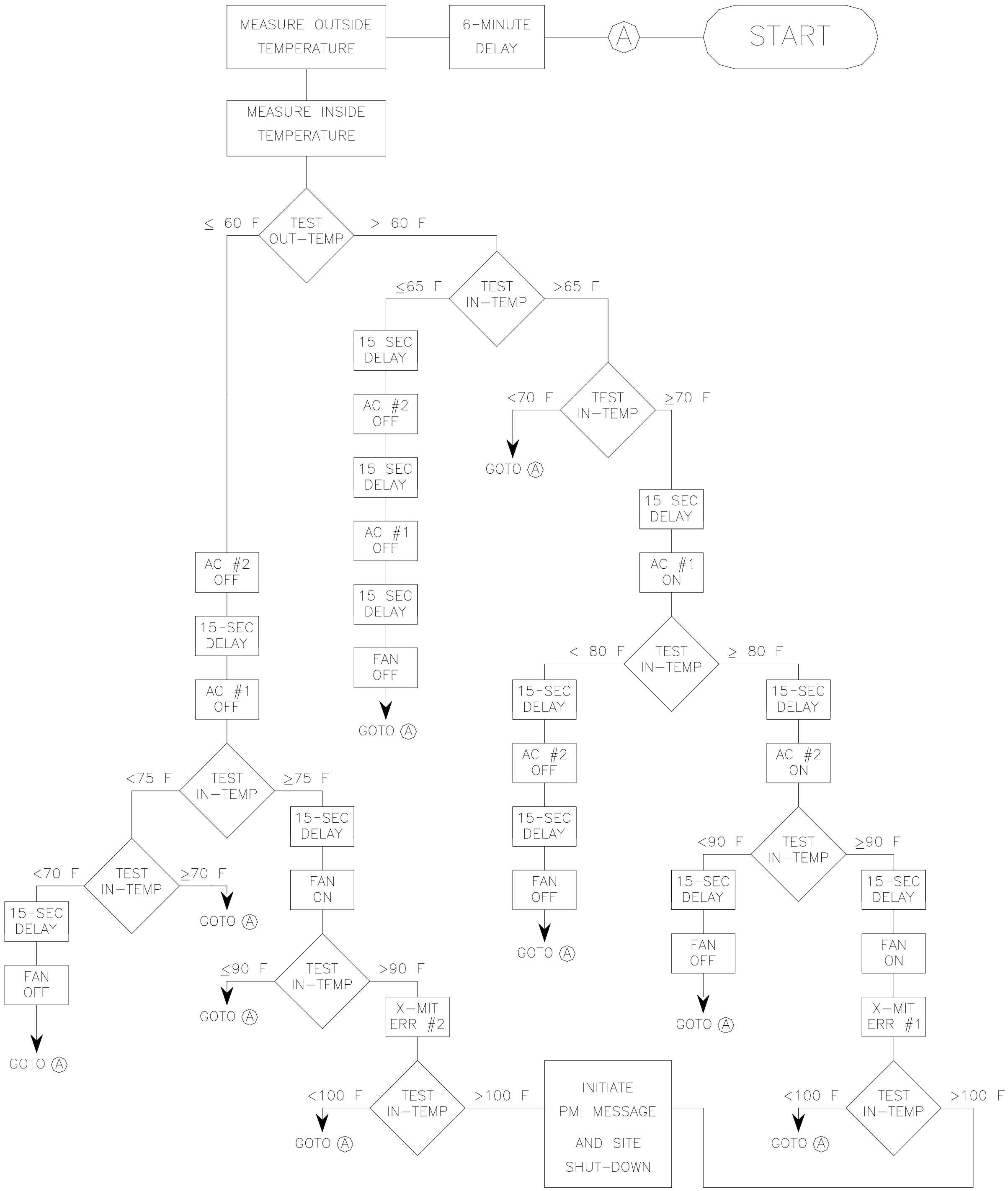


Figure 3-2 Shelter Temperature Control Algorithm Flow Chart

3.1.1 Temperature Sensors and Meters

The SSM contains two integrated temperature meters that provide the interfaces between the temperature sensors and the SSM Intel 186/03A computer. The displays of these meters are on the front panel of the SSM.

The temperature sensors are connected to the temperature meters via thermocouple cables (see Figure 3-3). There are four pairs of screw terminations between the temperature sensors and the input of the temperature meters. If the connections between the sensor and the meter are not making reliable contact, the meter will display the number "1" in the left-most position (in the same way a digital ohm meter displays an over-range condition with an open load).

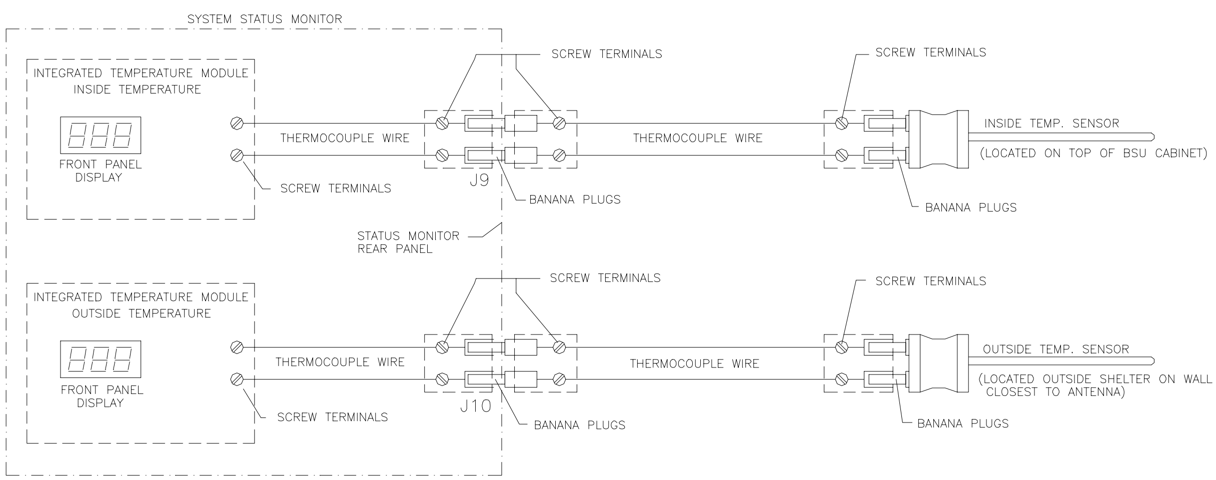


Figure 3-3 Inside/Outside Temperature Sensor Connections

If this condition affects the inside temperature sensor, the SSM computer "assumes" that the shelter temperature exceeds 100 F (37.5 C) and trips the main breaker. If the condition affects the outside temperature sensor, the environmental control algorithm will not function correctly and may turn on the ECUs when the outside air temperature is too low. If the ECUs run for prolonged periods while the outside temperature is below 50 F (10 C), damage to the A/C compressors may result.

To correct a temperature sensor reading error, trace the thermocouple wires to every point of connection between the sensor and the temperature meter, and tighten the screw terminals or reconnect the wires, as required. It may be necessary to open the SSM top cover and tighten the internal connections between the temperature meter and the rear panel. All plug contacts should be checked for corrosion or oxidation. If corrosion is found, clean the contacts on both male plugs and female receptacles.

3.1.2 Shelter Heat Sensor

The Shelter Heat Sensor, essentially a "normally closed," single pole-single throw (SPST) switch, is located in the center of the shelter ceiling (see Figure 2-6). Figure 3-4 shows the heat sensor and its components, and Figure 3-5 shows the heat sensor wiring terminations to the SSM.

A metallic element in the sensor, which resembles a stainless steel washer holds down a spring-loaded actuator, which, in turn, holds the switch in the open position. The metallic element consists of two parts chemically welded together. If the temperature inside the shelter reaches 135 F, the chemical bond holding the element in place melts. This causes half of the element to drop out of the unit, thereby closing the heat sensor switch. The SSM detects this switch closure and after a 30 second delay, trips the main breaker in the shelter.

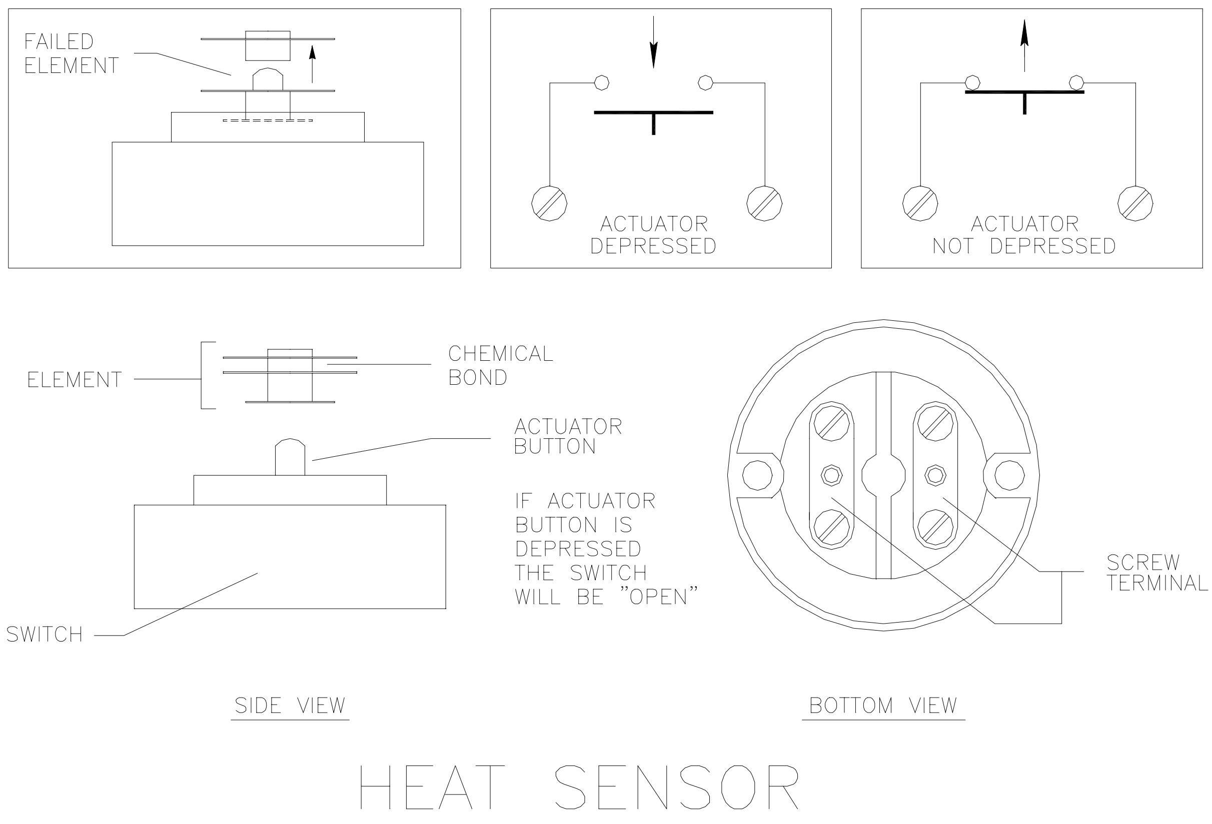


Figure 3-4 Shelter Heat Sensor Operation

If the heat sensor element has separated or failed, half of the element will probably fall out and land on top of the Power Amplifier (PA) Cabinet. Under these circumstances, the heat sensor must be repaired, which usually involves replacing the element that holds the switch actuator in place.

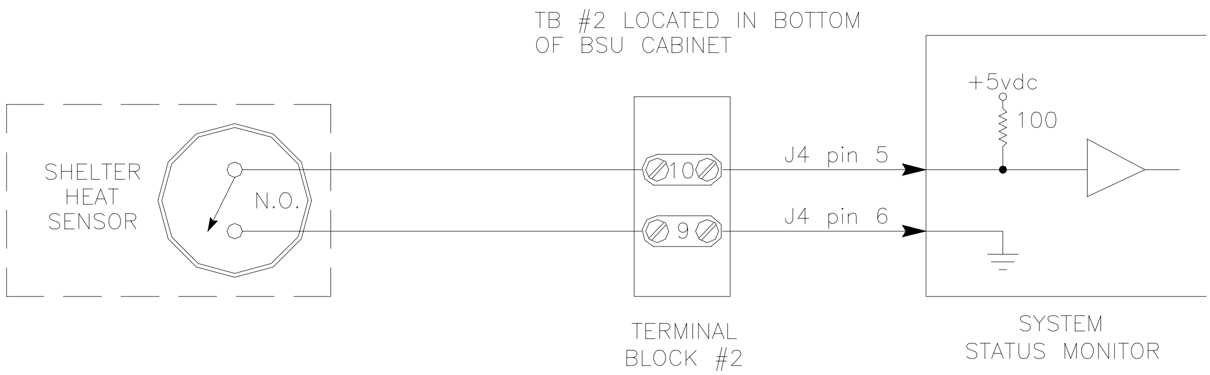


Figure 3-5 Shelter Heat Sensor Wiring Terminations

Replacing the Shelter Heat Sensor Element

1. Press on the center of the element and rotate it slightly in a clockwise direction to remove it from the switch. When the key holes are properly aligned, the element can be removed (see Figure 3-6).

2. Remove the two mounting screws from the switch section of the heat sensor, and the two wires from the terminal blocks. Use an ohm meter to test the continuity between the switch terminal blocks located on the underside of the switch housing. With the element removed, the resistance between the terminals should be shorted, or "closed".

3. Install the new element and perform the resistance measurement between the sensor's terminal blocks. With the element installed, the resistance between terminals should be infinite, or "open". If the switch is still "closed," reinsert the element and test the terminal resistance again.

4. If the switch reacts as expected, reconnect the two wires and reinstall the unit. Take care not to disturb the position of the element once it has been adjusted.

5. If the switch still does not work properly, the sensor can be by-passed temporarily until a new one can be installed. To by-pass the heat sensor, remove the wires from the sensor's terminal blocks and insulate the wire ends to insure that they will not touch and cause a short circuit.

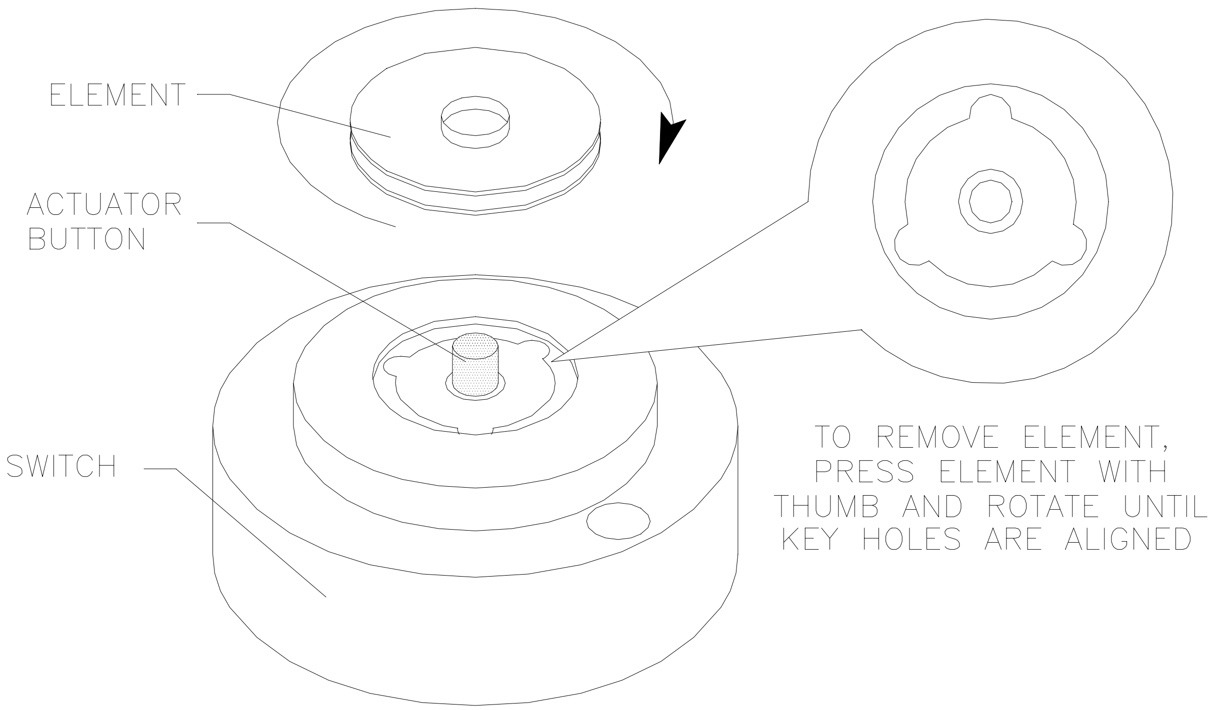


Figure 3-6 Heat Sensor Element Removal/Replacement

3.1.3 Environmental Control System Test

An effective method of verifying the proper operation of the environmental controls and the SSM is to simulate an "over temperature" situation inside the shelter. This activity tests both of the A/C control relays, the exhaust fan control relay, the Main Breaker Trip Control Relay, and the System Status Monitor relay driver circuits.

If the outside temperature is below 60 F (15 C), simulate outside temperatures above 60 F by unplugging the Outside Temperature Sensor from connector J10 on the rear panel of the SSM.

To simulate a condition where the inside shelter temperature exceeds 90 F (30.0 C), a heat gun can be used to heat the inside temperature probe (located on top of the BSU Cabinet, see Figure 2-4). Wave the heat gun along the top third of the inside temperature probe and gradually (over a span of 6 to 12 minutes) simulate raising the inside temperature to approximately 33 C. Hold the temperature at 33 C for another 6 to 12 minutes. The following sequence of events should occur:

1. One ECU should turn on.

2. After an interval, the second ECU should turn on.

3. Once both ECUs have turned on, unplug the inside temperature probe from it's mating connector. The following sequence of events should occur:

4. After an interval, the exhaust fan should come on.

5. After about 3 - 6 minutes, the SSM should shut down the site by tripping the Main Breaker.

   If this sequence of events occurs, the environmental control system is functioning properly. Reconnect the inside and outside temperature sensors. Note that the sensor connectors are polarized and that the sensors can only be inserted one way. Turn off Breakers #17/#19, #22, and #24, and reset the Main Breaker. Follow the standard Power Up sequence in Section 2.4.

   If this series of events does not occur, the SSM relay driver circuit or other components of the environmental control system may be faulty, and further troubleshooting will be required to isolate the problem. The following sections provide information on troubleshooting the SSM Relay Driver Circuit and the environmental control relays.

3.1.4 System Status Monitor Relay Driver Circuit

The environmental control relays are controlled by the SSM relay driver circuit (Figure 3-7) located on the Digital Interface Board inside the System Status Monitor. The circuit uses a transistor switch to activate the Solid State relays, and is typical of all wind profiler environmental control system relay driver circuits including the ECUs, exhaust fan/ louver units, and the Main Breaker Trip Control Relay.

The relay control signals produced by the driver circuits are routed from the SSM to an intermediate terminal block located in the bottom of the BSU cabinet, and then to the relay control boxes and Main Breaker Panel. Figure 3-8 illustrates the routing of the control signal wires and the configuration of the terminal block in the BSU cabinet.

3.1.5 Environmental Control Relays

The environmental control relays manage the shelter air conditioners, exhaust fan and louvers, and the main breaker trip mechanism. Two types of "Normally Open" Single Pole Single Throw (SPST) solid state relays are used. The first type is a 240 VAC, 40-

amp, solid-state relay, three of which control the ECUs and exhaust fan and the Louvers motors; the other type is a 110-VAC, 10-amp, solid-state device that trips the Main Breaker. Both types of relays require input voltage between 3 - 32 VDC to actuate.

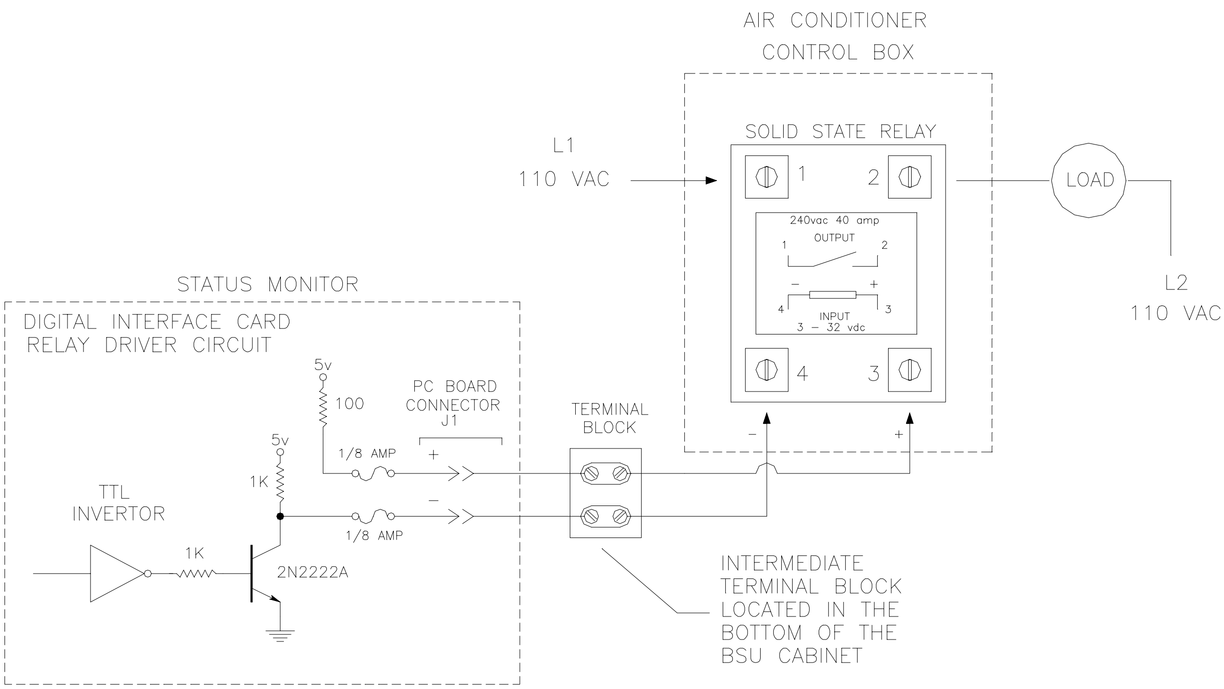


Figure 3-7 System Status Monitor Replay Driver Circuit

3.1.5.1 Air Conditioner Control Relays

The A/C control solid state relays are located inside the ECU control boxes near the air conditioner units. These relays are used to switch on and off one leg of the 220 VAC supply for the air conditioners. See Figure 3-9 for a schematic drawing of this circuit.

The positive control terminal of the relay (terminal 3) is pulled-up to +5 VDC through a 100 ohm resistor. The negative control terminal of the relay (terminal 4) is connected to a transistor which can switch voltage at terminal 4 from +5 VDC to ground (0 VDC). When a Digital Volt Meter (DVM) is used for voltage measurements at the relay control terminals, bias the meter according to the polarity of relay terminals 3(+) and 4(-).

When the SSM actuates the solid-state relay, a differential voltage of approximately +5 VDC will be present at terminals 3 and 4 of the Solid State relay. The open-circuit (no load) resistance measured between terminals 1 and 2 of the relay should be approximately 4 megohms.

When the SSM deactivates the solid-state relay, a differential voltage of approximately +0 VDC will be present at terminals 3 and 4 of the Solid State relay. The open-circuit (no load) resistance measured across terminals 1 and 2 of the relay should be greater than 8 megohms.

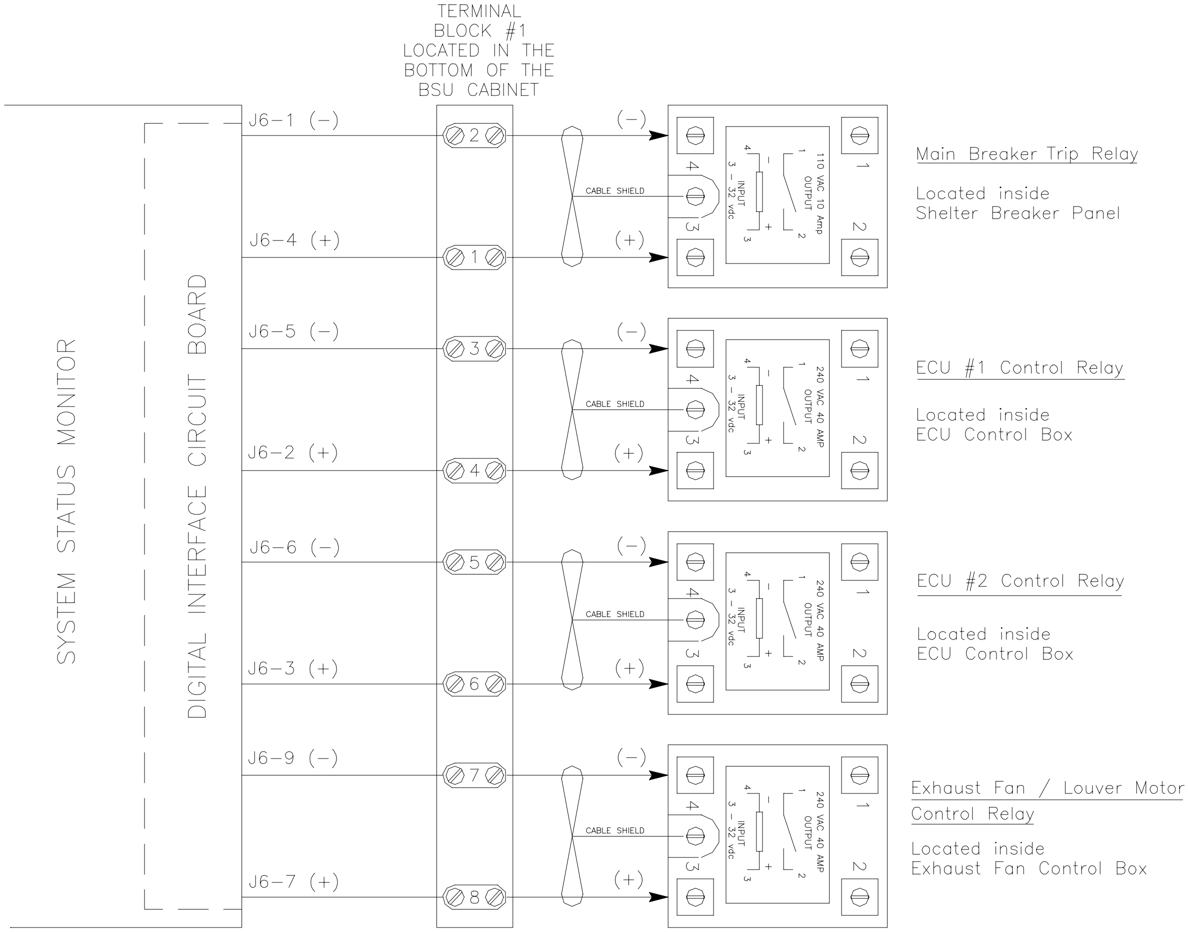


Figure 3-8 Solid State Relay Control Signal Wiring

Air Conditioner Relay Replacement Procedure

***** CAUTION *****

The air conditioner units operate on 220 VAC. Insure that the proper breaker is switched off before opening the bypass box. Air Conditioner 1 operates from Breaker #12/#14; Air Conditioner 2 operates from Breaker #9/#11. See Figure 2-9 for the breaker panel layout.

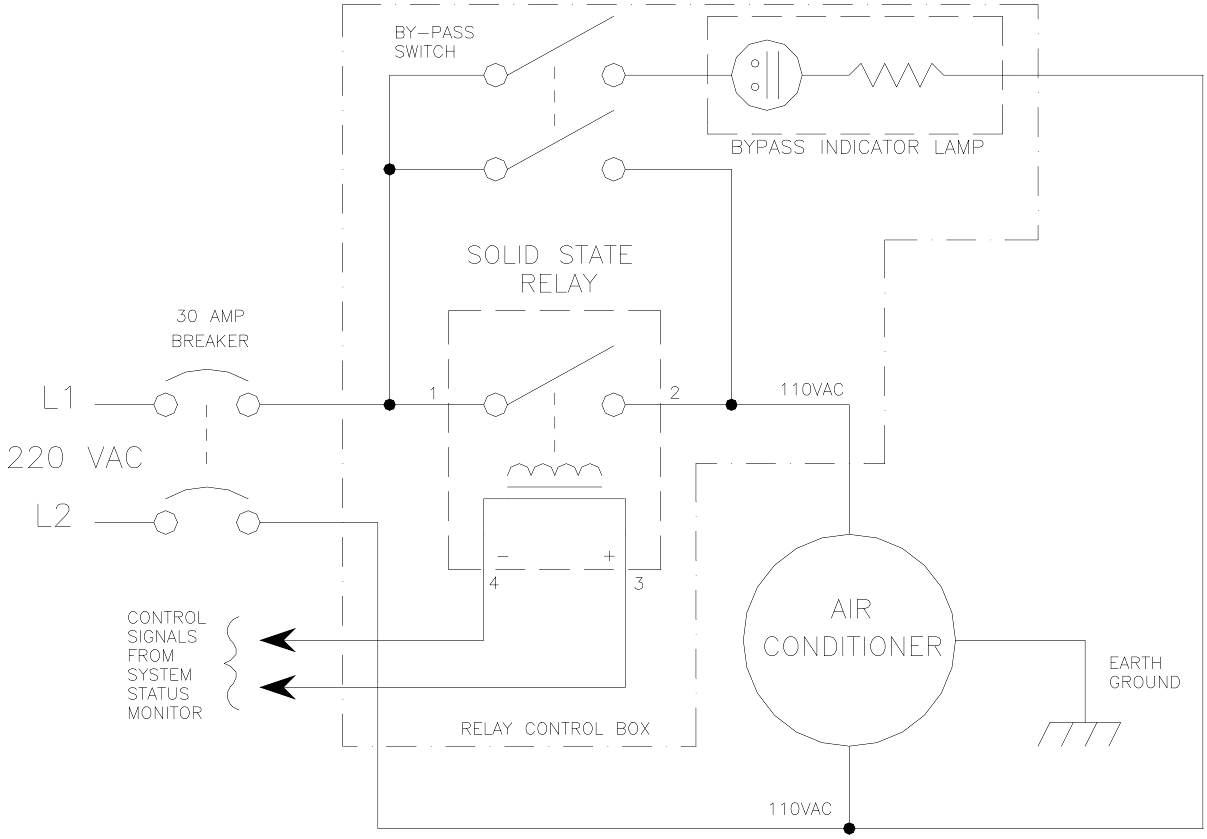


Figure 3-9 Air Conditioner Control Box Schematic Diagram

1. Unplug the air conditioner power cord from the ECU control box (see Figure 2-2 and Figure 2-3 for the locations of the control boxes). Use a DVM to confirm that no voltage is present in the box receptacle when the bypass switch, located on the ECU control box, is set to "bypass".

2. Remove the four mounting screws from the cover plate and the heatsink of the ECU control box.

3. Swing the face plate and heatsink away from the ECU control box as shown in Figure 3-10.

4. Loosen or remove the four terminal screws on the relay, and remove the power and control wires (see Figure 3-10).

5. Remove the two mounting screws from the relay and remove the relay from the heatsink.

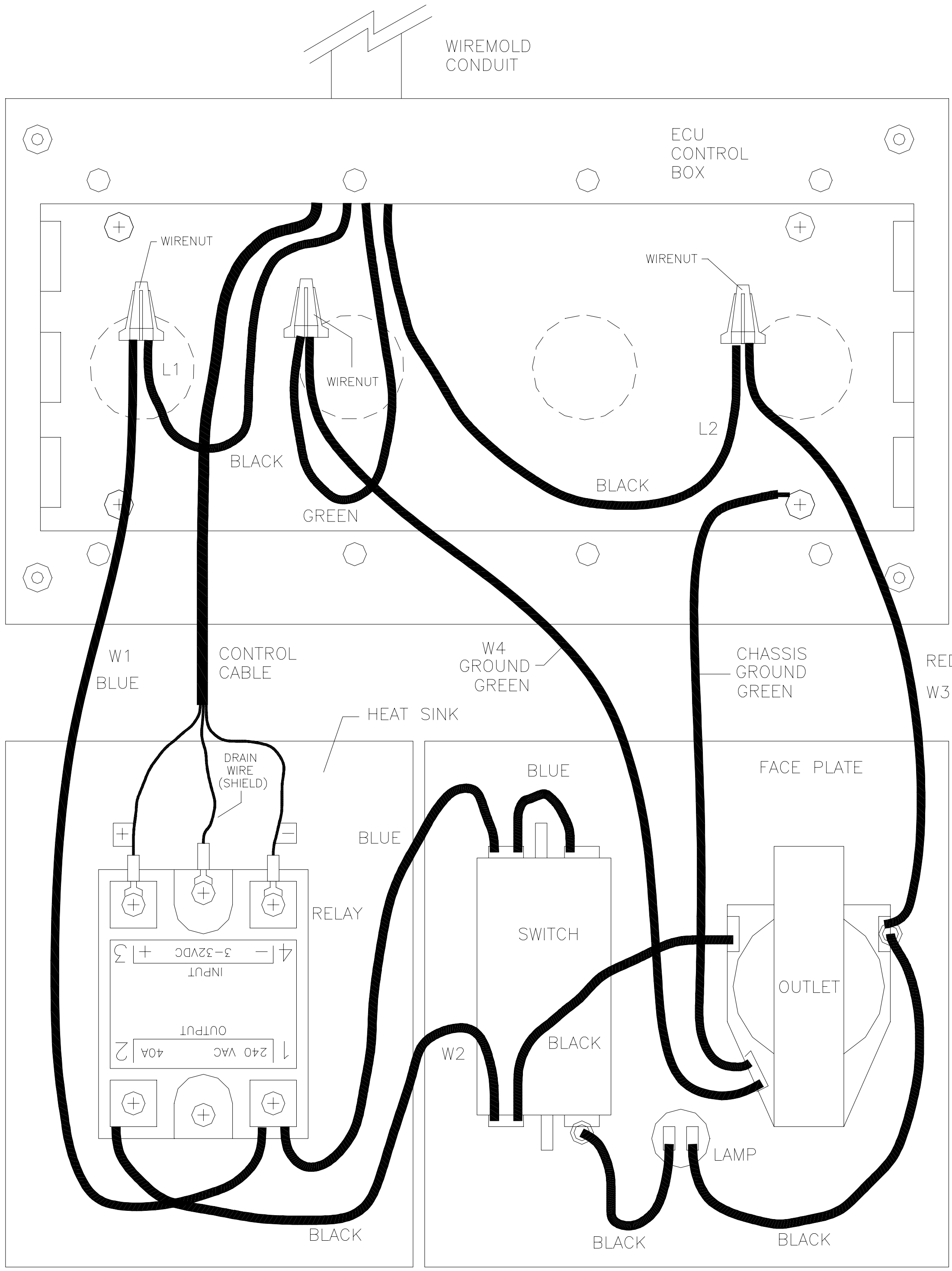


Figure 3-10 Air Conditioner Control Box Wiring Diagram

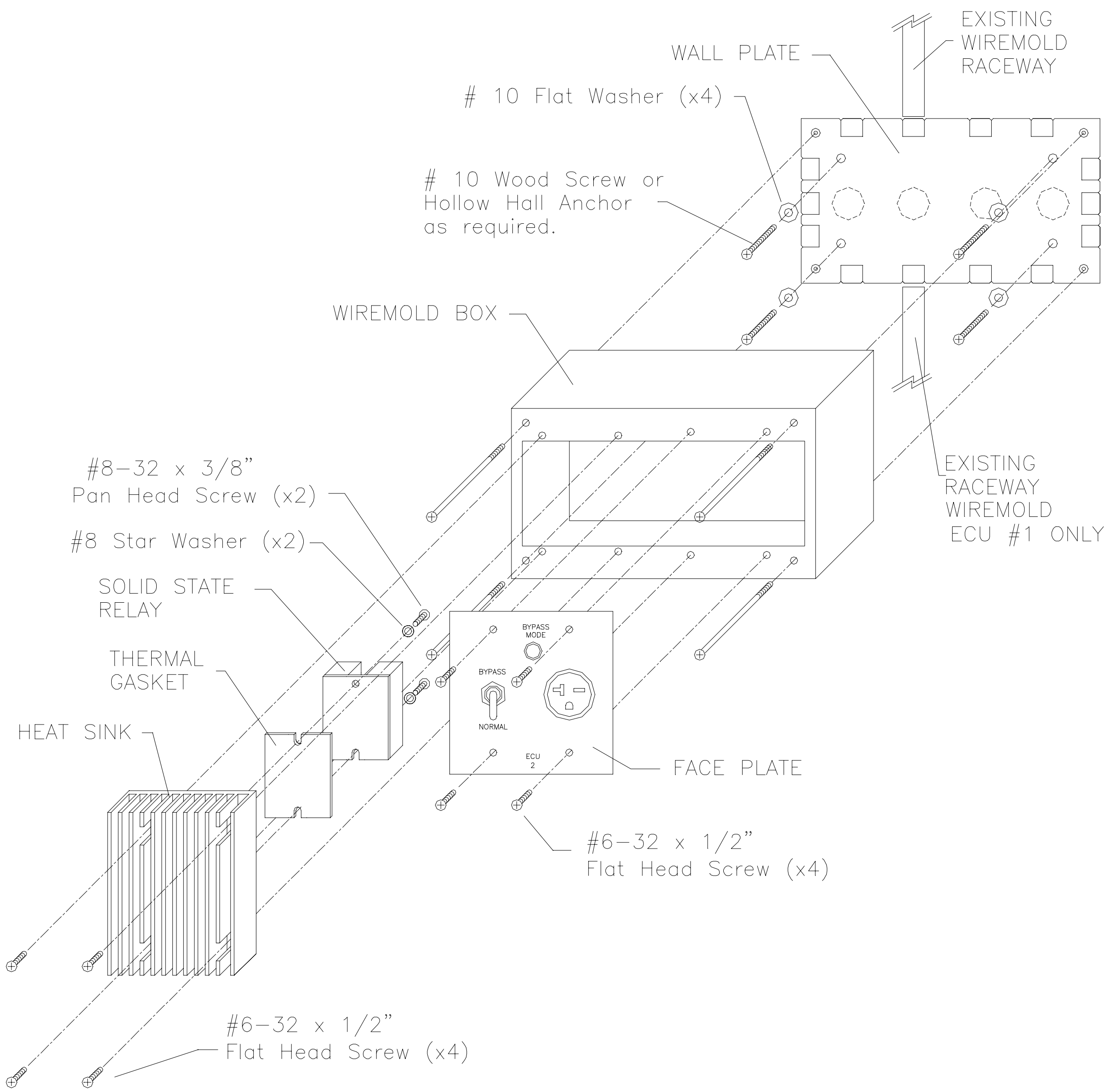


Figure 3-11 Air Conditioner Control Box Mechanical Assembly Diagram

6. Inspect the metal backing of the new relay for any irregularities or debris that may inhibit contact between the heatsink and the relay. Clean the contacting surface of the heatsink to remove any residue that may interfere with the contact.

7. Place the thermal gasket (supplied with the replacement relay) on the heatsink surface and attach the new relay to the heatsink as shown in Figure 3-11. Be sure to tighten the relay's mounting screws securely.

8. Connect the control and power wires to the relay.

9. Replace the face plate and heatsink on the ECU control box and reconnect the air conditioner.

10. Turn on Breaker #12/#14 for A/C #1, and/or Breaker #9/#11 for A/C # 2.

11. Place the bypass switch in the "bypass" position to ensure that the A/C unit functions properly. Place the bypass switch in the NORMAL setting when proper operation is verified. After an air conditioner is switched off, it should remain off for at least 5 minutes to prevent a short cycle condition that will trip the ECU's circuit breaker due to a excessive current load.

12. Verify computer control of the ECU by performing the Environmental Control System Test described in Section 3.1.3.

3.1.5.2 Exhaust Fan and Louvers Motor Relay

The exhaust fan and louvers motor relay is controlled by the System Status Monitor (SSM) and switches the 110 VAC supply required by the exhaust fan temperature controller and the two louver motors. The relay is located inside the exhaust fan control box on the wall next to the BSU cabinet (see Figure 2-4). Figure 3-12 is a schematic diagram of the exhaust fan control system.

Exhaust Fan and Louvers Relay Replacement Procedure

> ***** CAUTION *****
>
> The Cooling Fan and Louvers operate on 110 VAC. Insure that Breaker #13 is switched *OFF* before opening the Bypass Box.

1. Remove four mounting screws from the cover plate of the bypass box.

2. Swing face plate away from bypass box.

3. With the switch in the "bypass" position, use a DVM to confirm there is no AC voltage present anywhere in the circuit.

4. Loosen or remove (if necessary) the four terminal screws on the relay and remove power and control wires.

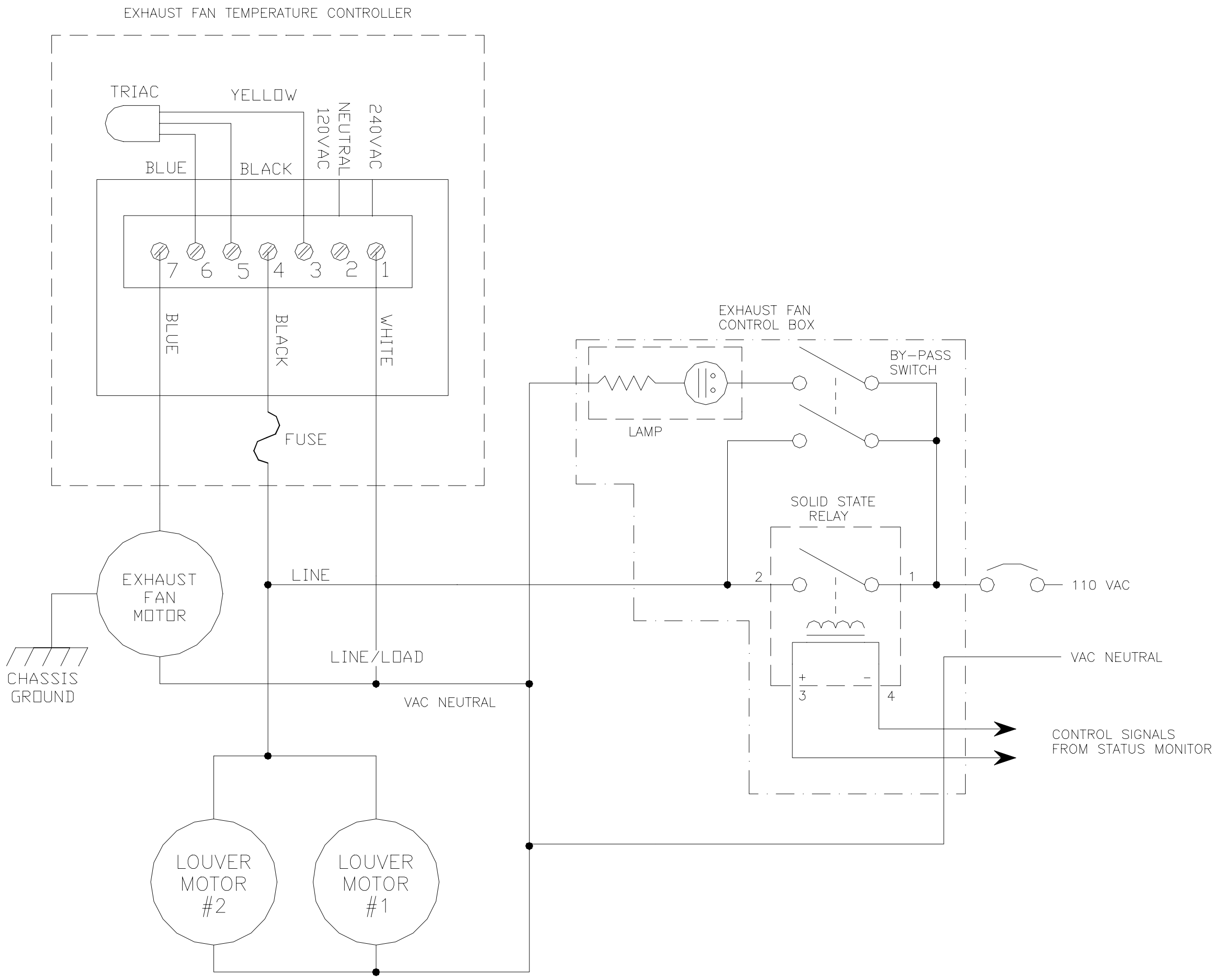


Figure 3-12 Exhaust Fan/Louver Control System Schematic Diagram

5. Remove the two mounting screws from the relay and remove relay from bypass box.

6. Connect the control and power wires to the relay prior to mounting the relay in the bypass box (see Figure 3-13 for a wiring diagram).

7. Mount the relay in the bypass box and fasten into position.

8. Replace face plate on bypass box.

9. Turn on Breaker #13.

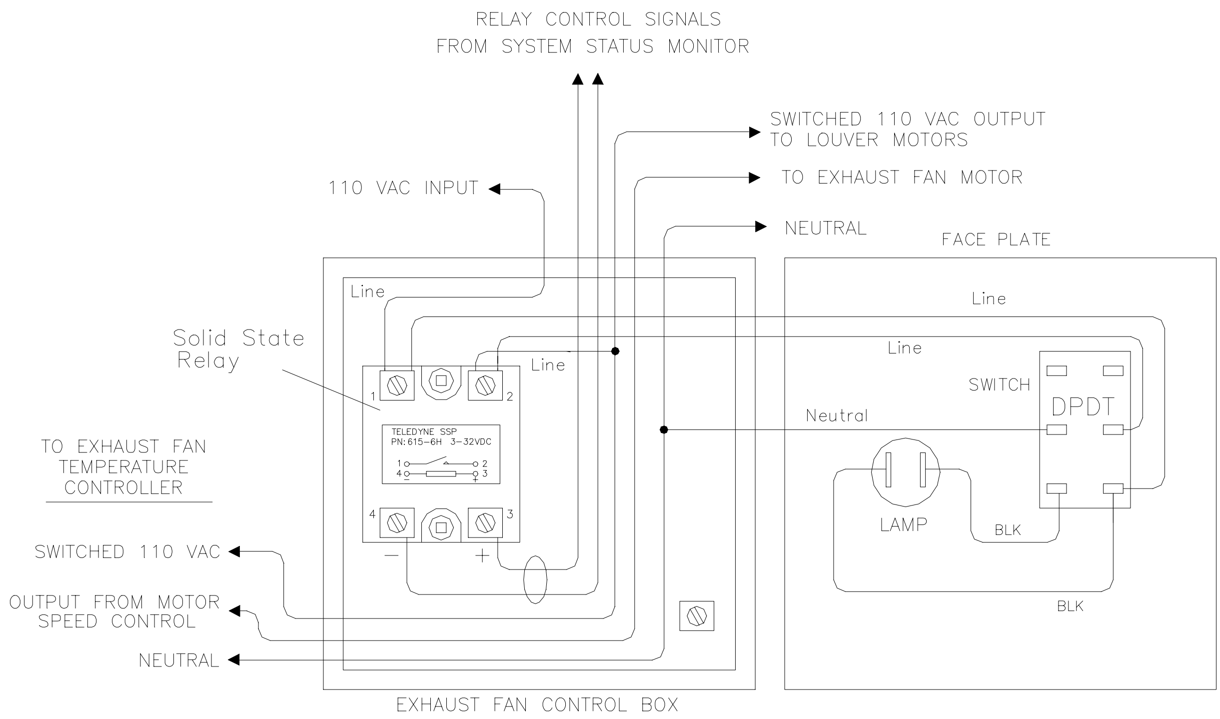


Figure 3-13 Exhaust Fan/Louver Control Box Wiring Diagram

10. Switch to bypass mode to test for proper operation.

11. Switch bypass switch to normal mode.

3.1.5.3 Main Breaker Trip Control Relay

The Main Breaker Trip Control Relay is located inside the Circuit Breaker Panel (see Figure 2-21). When the SSM senses a shelter over temperature, a smoke alarm, or a flooding condition, it energizes a shunt coil internal to the main breaker with 110 VAC, tripping the Main Breaker. Figure 3-14 is a schematic diagram of the Main Breaker Trip Control Relay circuit.

Main Breaker Trip Control Relay Replacement Procedure

1. Follow the standard power down sequence described in Section 2.3, then turn off the Main Breaker.

2. Remove the six mounting screws from the front of the Circuit Breaker Panel, and remove the panel.

***** CAUTION *****

Replacement of the Main Breaker Control Trip Relay requires the removal of the main breaker cover panel. For SAFETY, the main breaker must be *OFF* for this procedure. A flashlight or other means of lighting will be needed because the shelter interior lights will not be available once the main breaker has been turned off. Note that the shelter door can be propped open to allow light into the shelter.

3. Locate the solid-state relay on the inner left side of the breaker box. (see Figure 2-21). Remove the mounting screws from the relay and remove the device.

4. Disconnect the control cable and the power wires from the relay.

5. Reconnect the control cable and power wires to the new relay at the same terminals as the original relay.

6. Mount the new relay in the breaker box.

7. Replace the circuit breaker cover panel.

8. Turn on the Main Breaker following the standard Power Up sequence described in Section 2.4.

9. Perform the Environmental Control System Test described in Section 3.1.3 to verify proper operation of the Main Breaker Trip Control Relay.

3.1.6 Exhaust Fan Temperature Controller

The Exhaust Fan Temperature Controller (EFTC) controls how fast the exhaust fan motor turns at a given shelter temperature. The SSM monitors the internal shelter temperature (using the Inside Temperature Sensor as the reference), and uses the exhaust fan relay to activate the EFTC when the outside temperature falls below 60 F (15 C) and the inside temperature is outside of a predetermined range. The EFTC, illustrated in Figure 3-15, is located on the wall of the shelter next to the BSU cabinet (see Figure 2-4).

The speed of the exhaust fan is determined by the internal temperature and the settings of two potentiometers: TEMP and IDLE. The TEMP adjustment sets the temperature threshold "turn-off" point that is measured by an integral temperature sensor located just below the EFTC behind the RF shield. The IDLE adjustment determines how fast the fan spins after the motor has turned on. Under normal circumstances, the TEMP adjustment is set to 65 F (18 C) and the IDLE adjustment is set to maximum.

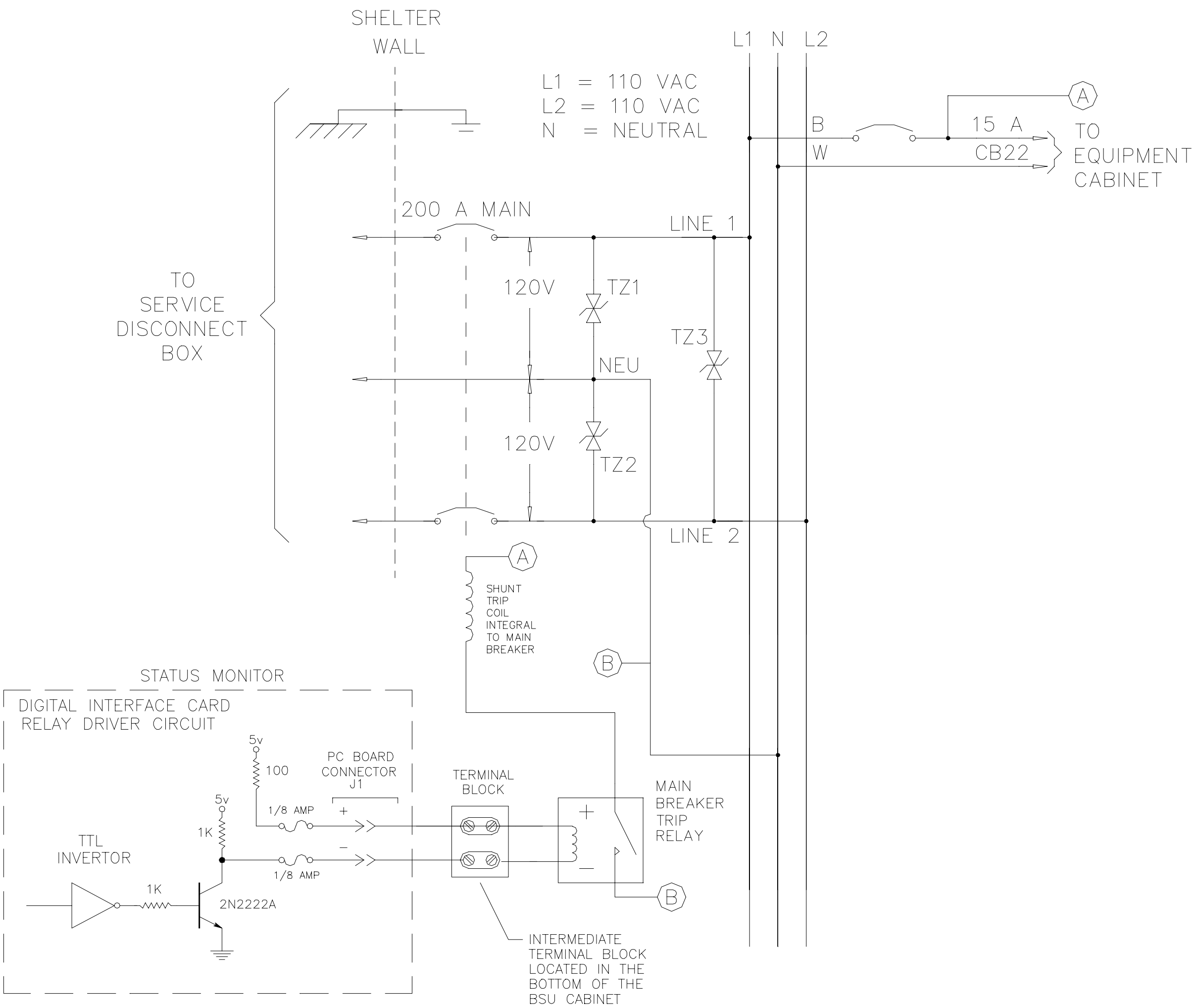


Figure 3-14 Main Breaker Trip Replay Circuit Schematic Diagram

Exhaust Fan Temperature Controller Replacement Procedure

1. Turn off Breaker #13.

2. Remove the four screws (designated "A" in Figure 3-15) that hold the cover of the Phason controller to its case.

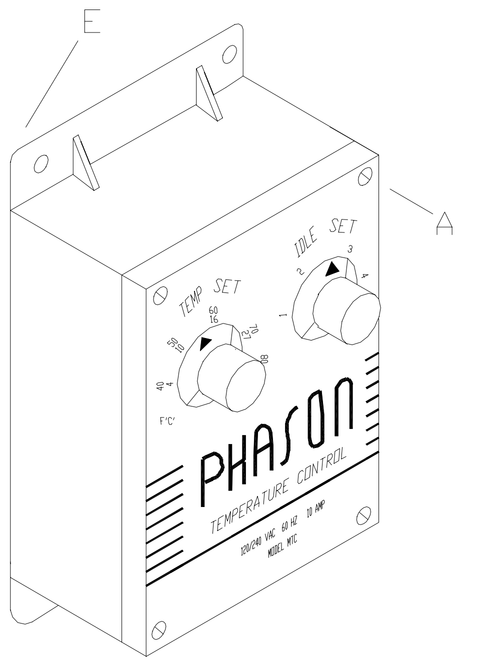


Figure 3-15 Exhaust Fan Temperature Control Unit

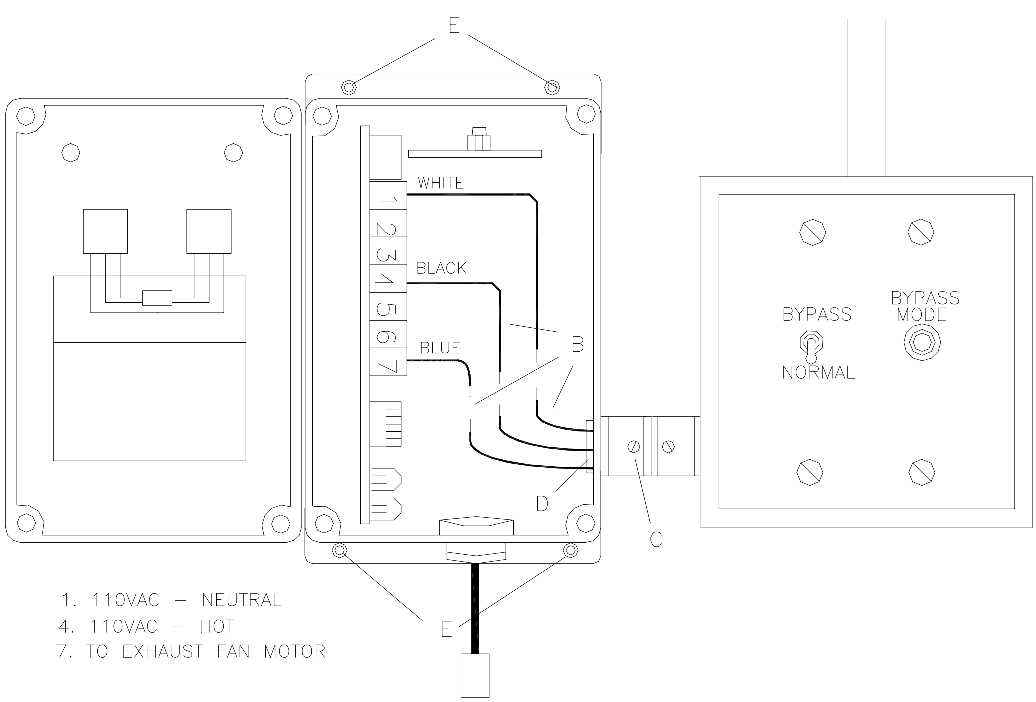


Figure 3-16 Exhaust Fan Control Unit Wiring Diagram

3. Find the three wires (designated "B" in Figure 3-16) that connect the fan motor and the Fan Control Unit Terminal Strip. Note the colors and connections between these wires and the wires routed into the bypass box next to the Phason controller.

4. Remove the wire nuts and the electrical connections to the three wires.

5. Loosen the set screw and the assembly nut (designated "C" and "D", respectively, in Figure 3-16).

6. Remove the assembly nut and assembly conduit.

7. Remove the four screws (designated "E" in Figure 3-16) that hold the unit to the wall and remove the EFTC.

8. Mount and secure the new EFTC to the wall.

9. Reinstall the assembly conduit and assembly nut, and tighten the assembly nut as shown in Figure 3-16.

10. Tighten set screw "C" in Figure 3-16.

11. Re-connect the wires on the new fan motor to the wires on the Fan Control Unit Terminal Strip.

12. Replace the cover plate and adjust the TEMP setting to 65 F (18 C) and the IDLE setting to maximum.

13. Turn on Breaker #13.

14. Turn on the bypass switch to "BYPASS, then back to NORMAL to ensure the exhaust fan motor operates.

3.2 Louver Assemblies

The shelter is equipped with two louver assemblies located by front and rear doors of the shelter (see Figure 2-2 and Figure 2-5). The louvers are opened by the louver motors when the exhaust fan is running, and closed tightly when the exhaust fan is off. Figure 3-17 depicts a side view of the louver assembly and its components. Figure 3-18 and Figure 3-19 are photographs of the intake louver assembly in the closed and open positions. Figure 3-20 and Figure 3-21 are photographs for the exhaust louver assembly in the closed and open positions.

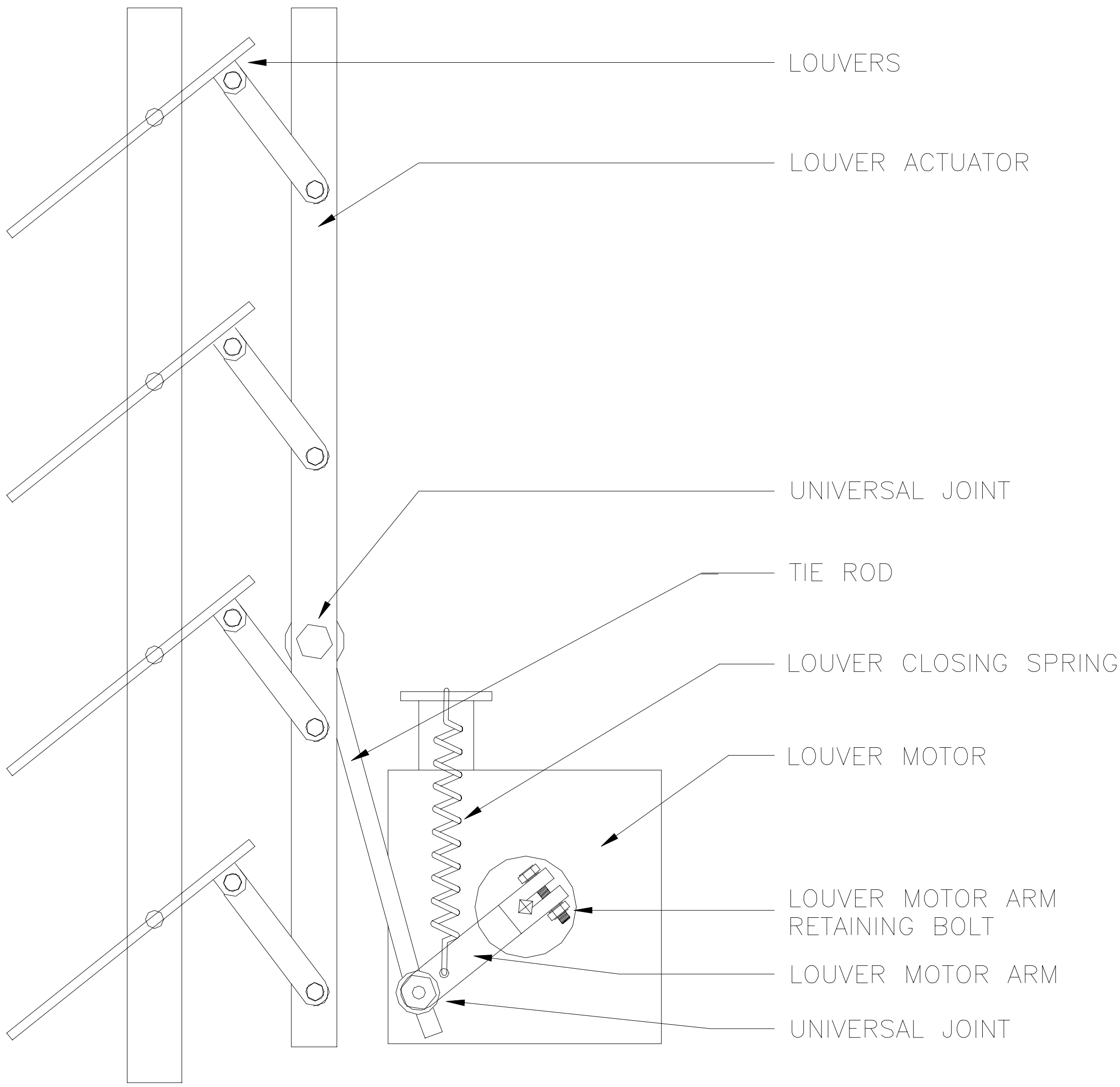


Figure 3-17 Side View of the Louver Actuator Assembly

Figure 3-18 Intake Louver Closed

Figure 3-19 Intake Louver Open

Figure 3-20 Exhaust Louver Closed

Figure 3-21 Exhaust Louver Open

3.2.1 Common Failures of Louver Assemblies

Since the actuation of the louvers is mechanical, the assembly is prone to failures. The most common modes of failure include:

- The louver motor arm, universal joint, or retaining bolt becomes loose over a period of time.
- The louver motor arm breaks where it is attached to the motor shaft.

- The louver spring breaks, which causes the louver to remain open continuously.
- The louver motor fails.

Proper operation of the louvers is critical to the environmental control of the shelter temperature, especially during the winter months. Therefore, it is necessary to inspect the mechanical integrity of the louver assemblies at each 6-month preventive maintenance cycle. It is recommended that the louver assemblies be tested during each site visit. The louver assemblies can be tested by temporarily switching the shelter exhaust fan to BYPASS mode and visually verifying that both louvers open while the fan is running and close tightly when the switch is returned to NORMAL mode.

3.2.2 Louver Assembly Repair Procedure

The following procedures describe how to access and replace the various components of the louver assemblies and how to test the louver assemblies for proper operation.

Accessing the Louver Assemblies

To gain access to the intake louver assembly, remove the intake filter from the fiberglass housing and remove the grill from the front of the housing.

Gaining access to the exhaust louver assembly requires removing the shelter exhaust fan from the wall. To remove the exhaust fan from the wall, perform the following procedure.

1. Turn off breaker # 13 on the shelter breaker panel.
2. Remove the cover from the junction box located next the exhaust fan.
3. Disconnect the exhaust fan's AC power wires inside the junction box.
4. Remove the nut which fastens the flexible conduit to the junction box and remove the conduit from the junction box.
5. Remove the mounting screws of the exhaust fan and remove the entire assembly from the wall.

Louver Motor Arm and Spring Replacement Procedure

If the louver motor arm has failed, install the new louver motor arm, tighten the retaining bolt, and connect the universal joint and louver spring. Test the operation of the louver assembly by restoring AC power and temporarily turning the exhaust fan to BYPASS mode. The tie rod may need to be adjusted for proper operation.

If the spring has failed, install the new spring and test the operation of the louver assembly by restoring AC power and temporarily turning the exhaust fan to BYPASS mode.

Louver Motor Replacement Procedure

1. Turn off breaker # 13 on the shelter breaker panel.

2. Remove the cover from junction box located next the louver assembly (if not already done in the previous procedure).

3. Disconnect the AC power wires for the louver motor inside the junction box.

4. Remove the louver spring from the louver motor arm.

5. Loosen the louver motor arm retaining bolt and universal joint and remove the arm from the shaft of the motor.

6. Remove the mounting screws for the louver motor and remove the motor.

7. Install the new louver motor and replace the mounting screws.

8. Replace the louver motor arm on the motor shaft and re-install the universal joint and retaining bolt.

9. Reconnect the louver spring

10. Reconnect the AC power wires inside the junction box.

11. Turn on breaker # 13 and test the operation of the new louver motor by restoring AC power and temporarily turning the exhaust fan to BYPASS mode. The tie rod may need to be adjusted for proper operation.

12. If required, re-mount the exhaust fan assembly and reconnect the AC power wires inside the junction box, or, replace the Intake Louver grill and filter.

13. Replace the cover on the junction box next to the louver assembly.

3.3 Environmental Control Units (ECU)

The shelter is equipped with two ECUs (air conditioners) to provide cooling when the outside temperature rises above 15^o C (60^o F). The ECUs are commercial grade 22,000 BTU window-mount units manufactured by Gibson. The model number of the unit currently used is GAS228W2A (with AC plug style 3).

The System Status Monitor controls the ECUs through solid state relays that switch the 220 VAC line voltage to each unit. The control settings on the ECUs should be positioned so that the units provide their maximum continuous cooling capability.

3.3.1 Replacement Procedure

***** WARNING *****

The ECUs weigh in excess of 150 lbs. Removal and installation of an ECU requires two people to lift the unit!

1. Unplug the ECU's AC power cable from the ECU control box.

2. Remove the plastic face plate from the ECU.

3. Locate the pull-handle on the ECU and pull the unit out of the housing partially. Position two people to support and lift the unit, and remove the faulty ECU from the shelter.

4. Carefully remove the new ECU from its packaging. Do not mutilate the shipping packaging so it can be used to ship the old ECU back to the PPO in Boulder, CO (assuming the failed ECU can be repaired).

5. Remove the housing from the new ECU. The housing will not be used because the housing from the original ECU is permanently fastened to the shelter opening where the new ECU will be installed.

6. Prior to installing the new ECU in the shelter, clean out any debris from the grills and air filters of the ECU housing inside the shelter.

7. Install the new ECU in the shelter, but do not attach the plastic face plate or plug in the AC power cord. Refer now to step 3 of the Hard-Start Kit Installation procedure (see Section 3.3.2).

3.3.2 Hard-Start Kit Installation Procedure

The purpose of the Hard-Start Kit is to help minimize the start-up current draw of the ECU's compressor. ECUs without Hard-Start kits are likely to trip their circuit breaker during high-use periods of the summer months.

Parts Required:

Two (2) SPP-6 Super-Boost Kits

Special Tools Required:

Square head screwdrivers (Canadian Style), Size #2 and #3
Assorted sizes of Phillips and flat blade screwdrivers, Size #2 and #3
Pliers (regular and needle-nose).

***** Note *****
Do not turn off both air conditioners at the same time. Install the Hard-Start kits on one ECU at a time to maintain adequate temperature inside the shelter.

1. Turn off the ECU's circuit breaker. Unplug the ECU's AC power cord.

2. Remove the plastic front cover and air filter from the ECU as shown in Figure 3-22.

3. Pull the ECU out from the wall approximately eight inches using the handle located on bottom front of unit.

4. Remove the control knobs (i.e. Air Sweep, Fan Setting, Temperature) from the control panel of the ECU.

5. Remove the screws that fasten the control panel plate to the chassis (see Figure 3-23).

6. Remove the nut that fastens the louver base to the chassis (see Figure 3-23).

7. Disconnect the air sweep mechanism connected to the louver motor cam (see Figure 3-23).

8. Free the thermostat sensor from the front of the cooling coils, be careful not to kink or damage the thermostat tubing.

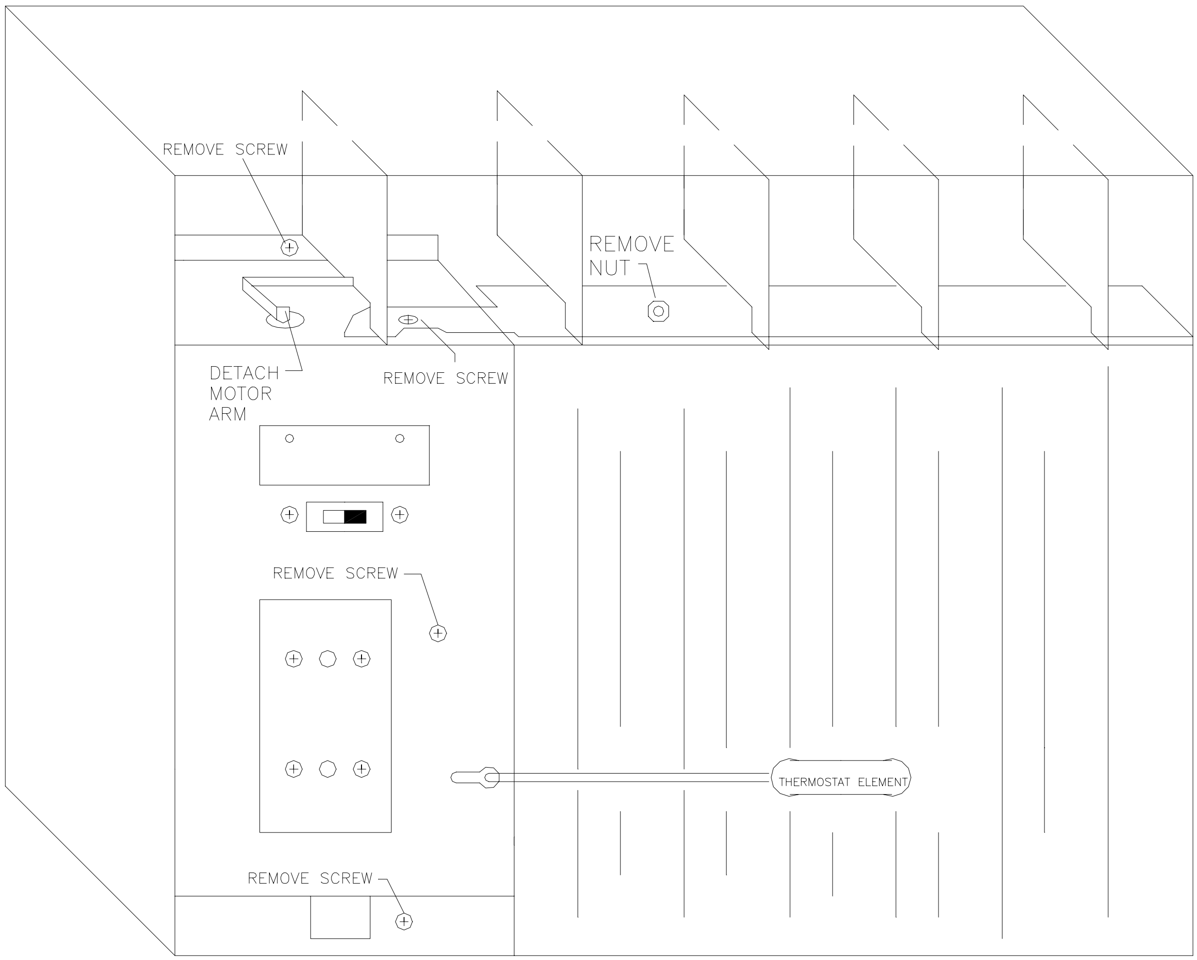


Figure 3-22 ECU with Front Cover Panel and Air Filter Removed

9. Pull the control panel out gently while lifting the air sweep louver to allow the control panel flange to slide under the air sweep mechanism.

10. The ECU starting capacitor is located behind the control panel (see Figure 3-23). The starting capacitor has three terminals, a brown wire is connected to the first terminal, two red wires and one white wire are connected to the center terminal, and one white wire is connected to the third terminal (see Figure 3-24).

11. Connect one lead of Hard-Start Kit to the terminal with the single white wire, and connect the other lead of the Hard-Start Kit to the terminal with the two red wires and one white wire, as shown in Figure 3-24.

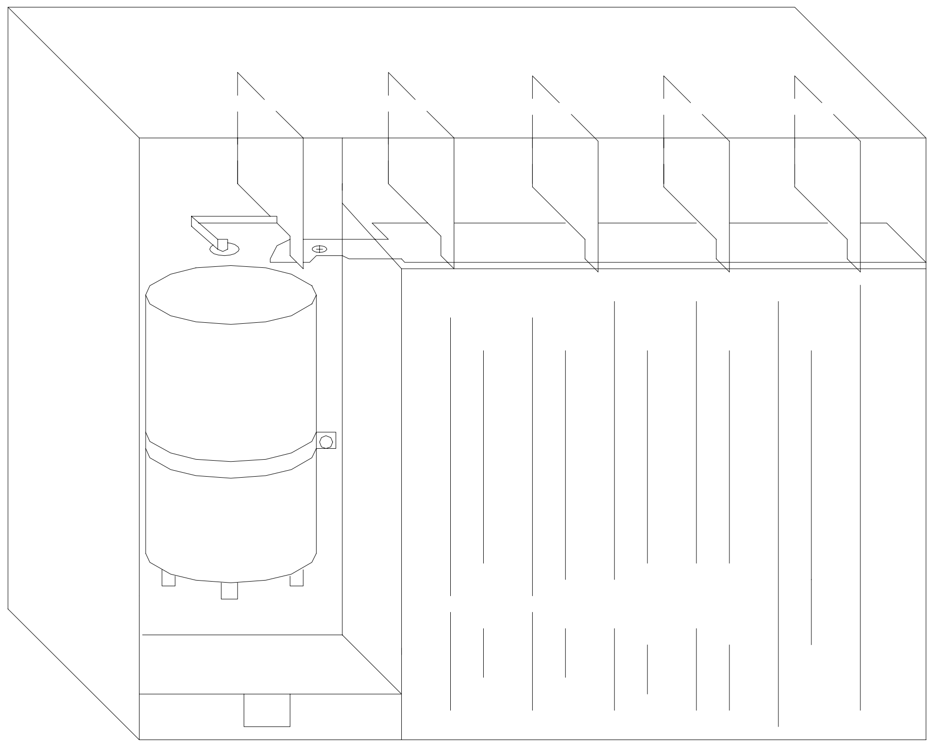


Figure 3-23 ECU Cover Plate Removed to access the Starting Capacitor

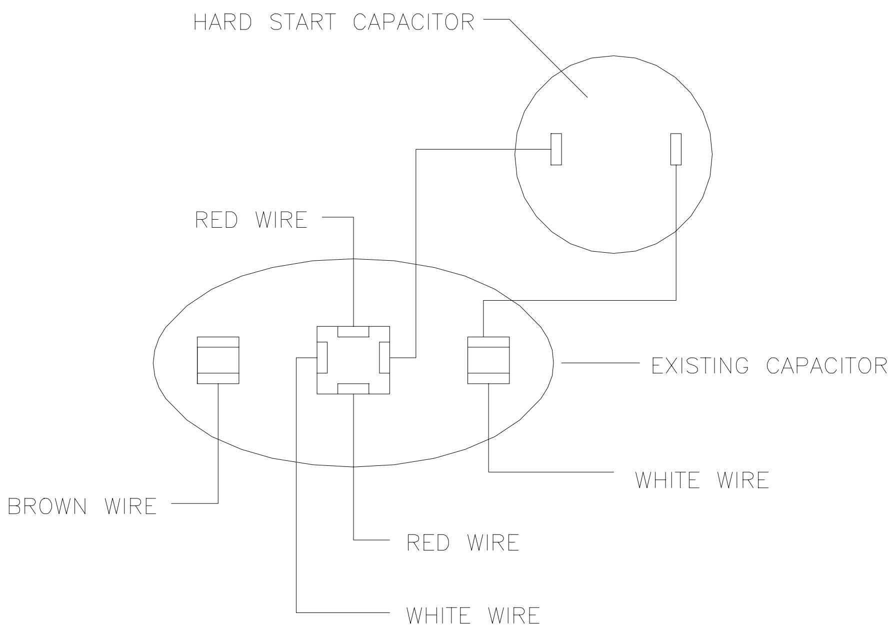


Figure 3-24 ECU Hard-Start Kit Wiring Diagram

12. Attach an adhesive cable tie mount to the inside of ECU chassis and mount the hard start kit with a nylon cable tie as shown in Figure 3-25.

13. Re-assemble the control panel, louver sweep arm, and thermostat sensor.

14. Re-install the control knobs, the air filter, and the plastic front cover.

15. Push the ECU back to its normal position in the shelter wall.

16. Plug the AC power cord into the ECU control box, and turn on the ECU circuit breaker.

17. Test the ECU by switching the ECU control box to BYPASS mode.

18.

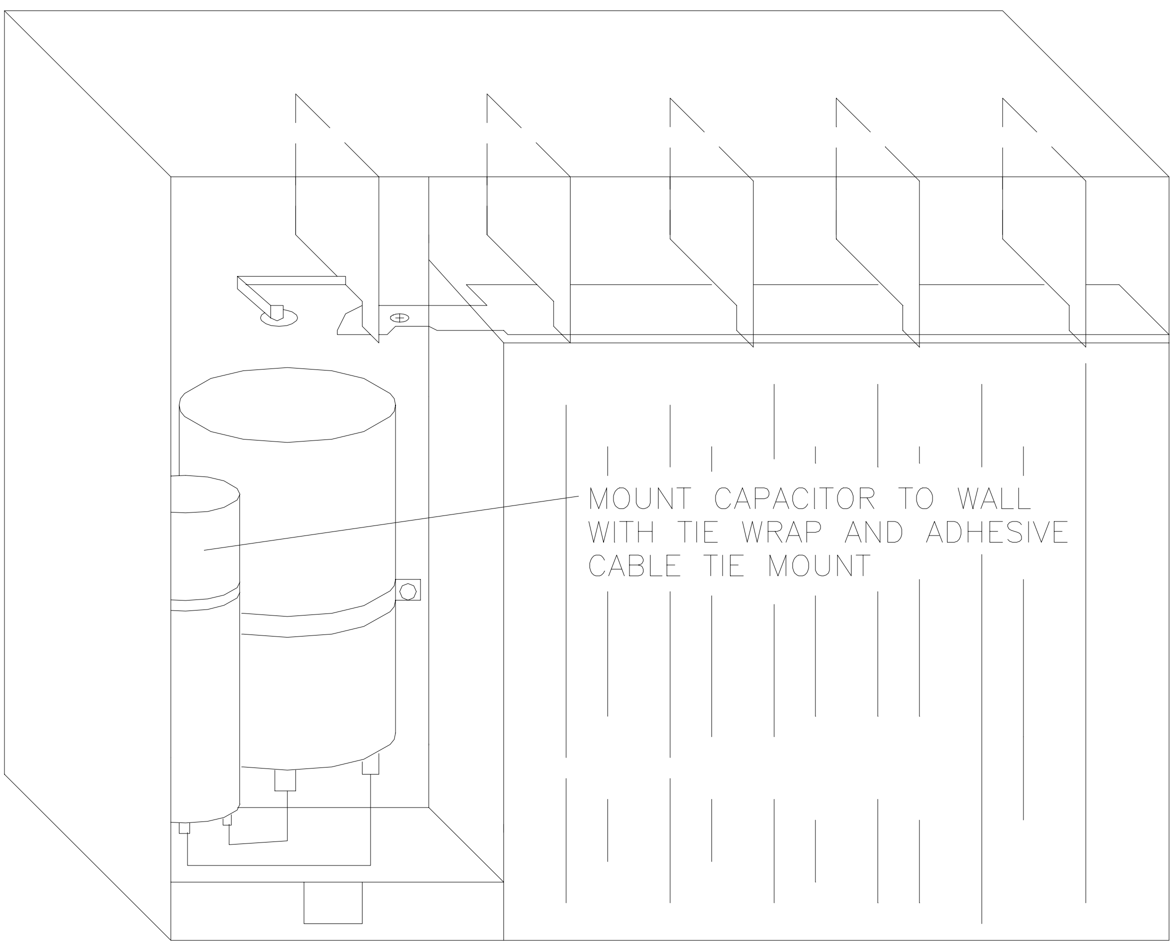


Figure 3-25 Mounting the Hard-Start Kit Inside the ECU

3.4 Smoke Detectors

The shelter is equipped with two smoke detectors located on either side of the heat sensor on the ceiling of the shelter (see Figure 2-6). The smoke detectors are powered by +28 VDC from Power Supply #2 located in the Equipment cabinet (see Figure 2-4). They are connected to normally "open" SPST switches that are wired in parallel to common lines monitored by the SSM. Figure 3-26 is a schematic diagram of the smoke detectors and SSM wiring terminations.

To assure that the detector is functioning, a pulsing LED (six times per minute) allows for visual supervision of the detector. Under alarm condition, the LED lights constantly at full brilliance.

If one or both of the smoke detectors is triggered, the closing of the SPST switch is detected by the SSM, which (after a 30 second delay) powers down the profiler by activating the Main Breaker Trip Control Relay as described in Section 3.1.5.3.

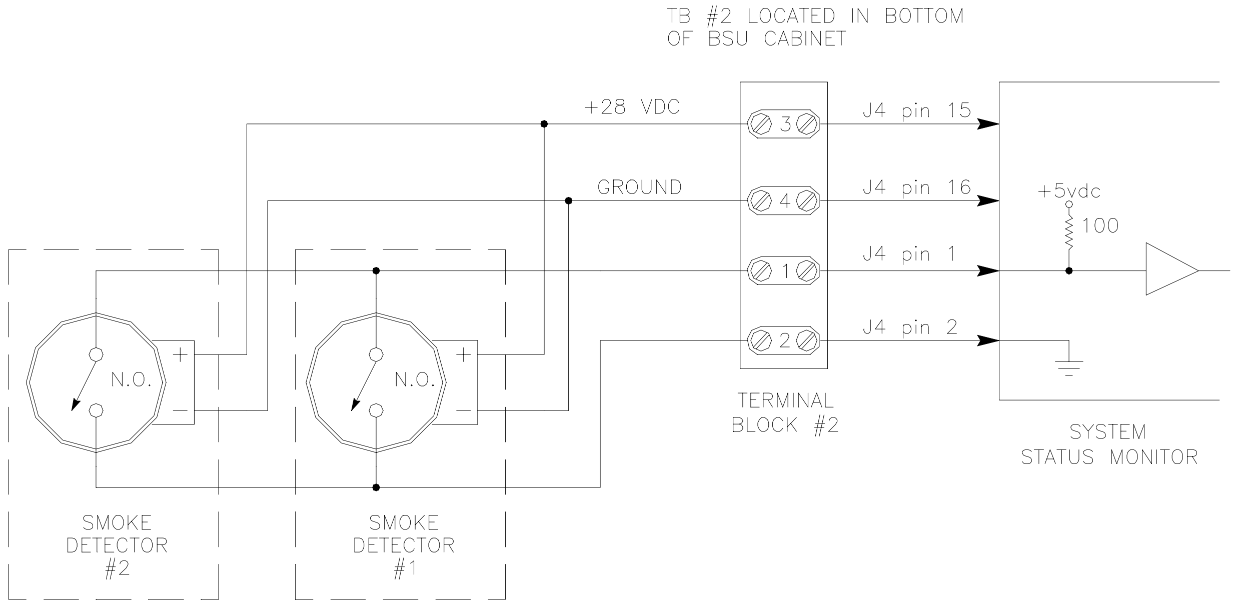


Figure 3-26 Shelter Smoke Detector Schematic Wiring Diagram

3.5 Flooding Sensor

The shelter is equipped with a flooding sensor mounted at floor level inside the Equipment Cabinet. The sensor is a normally "open" SPST switch actuated by a float mechanism and monitored by the SSM. Figure 3-27 is a schematic diagram of the flooding sensor and SSM wiring terminations. Refer to Figure 2-4 for the location of the Equipment Cabinet in the shelter.

If the flooding sensor is triggered, the closing of the SPST switch is detected by the System Status Monitor and the SSM will immediately power down the profiler by activating the Main Breaker Trip Control Relay as described in Section 3.1.5.3.

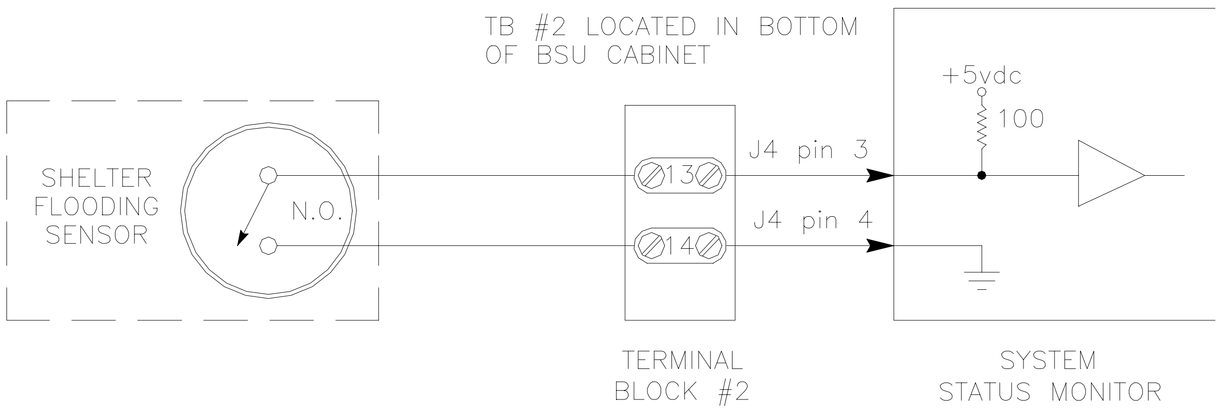


Figure 3-27 Flood Sensor Schematic Wiring Diagram

3.6 Shelter and Antenna Field Access Alarms

The front and rear doors of the shelter and the gate to the fence enclosing the profiler antenna field are equipped with access sensors monitored by the SSM. The sensors are two-part magnetic reed switches that are "closed" when the doors or gate are closed. Figure 3-28 is a schematic diagram of the access sensors and wiring terminations to the SSM.

3.6.1 Access Alarm Reporting

When any of the access sensors are tripped, the event is detected by the SSM, which logs it in its Fault Log and transmits the alarm to the Profiler Control Center Hub in Boulder, Colorado. Additional entries will be made every 6 minutes until the access alarm is cleared using the Profiler Maintenance Terminal (PMT) located in each shelter.

While at the site, it is acceptable to temporarily "jumper" the front door sensor to prevent the Fault Log from filling with "Shelter Access Alarms" after the Hub has been notified of the site visit. **DO NOT LEAVE THE FRONT DOOR SENSOR JUMPERED WHEN YOU LEAVE THE SITE.**

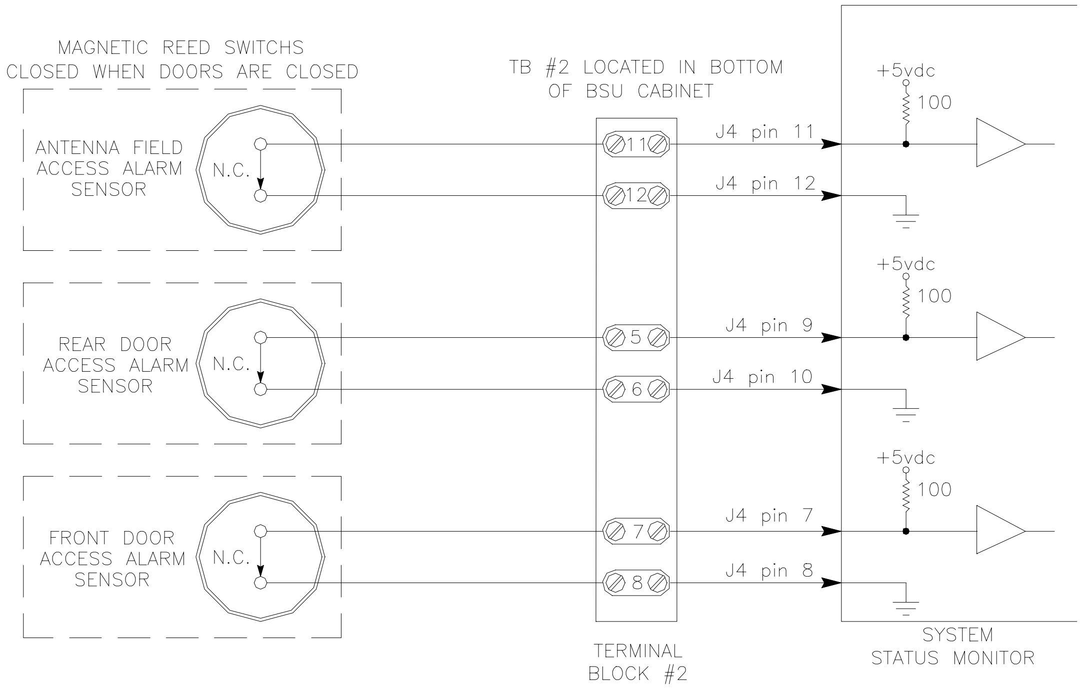


Figure 3-28 Access Alarm Schematic Wiring Diagram

3.6.2 Effects of Access Alarms

If any of the access sensors are tripped, an access alarm is filed in the Fault Log of the SSM and the event is transmitted to the Hub in Boulder, CO.

If the shelter rear door or the antenna fence gate is opened while the profiler is operating, the SSM will immediately disable the transmitter. If access to the antenna field is necessary, the profiler should be placed in Maintenance mode to inhibit the transmitter prior to entering. The alarm must be cleared using the procedure described in the next section before returning the profiler to Operational mode.

3.6.3 Resetting Access Alarms

An access alarm can be reset using the PMT while the profiler is in either Operational or Maintenance mode. Boot the PMT and select the Status Monitor Reset Menu from the Main Menu; options for immediate and 5-minute delayed reset are available.

The 5-minute delayed reset is most useful when vacating the site because it allows sufficient time to log off the profiler, unplug the PMT power and data cables, stow the PMT, turn off the lights, exit the shelter, and lock the shelter door.

4 Equipment Cabinet

The Equipment Cabinet is located in the corner of the Wind Profiler Shelter Assembly opposite both shelter access doors (see Figure 2-1 and Figure 2-4). Front and rear views of the Equipment Cabinet are presented in Figure 4-1 and Figure 4-2, respectively.

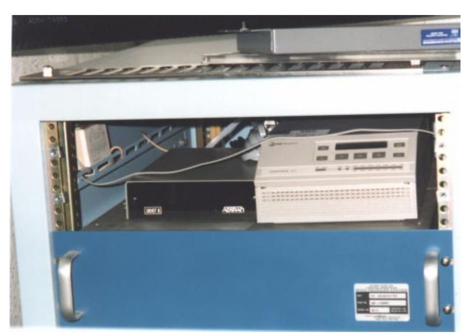
The Equipment Cabinet contains the following items: the RF Generator, also referred to as the Exciter; the Forward Power Sensor; the Diode Detectors; the Data Processor Assembly; the Signal Processor Assembly; the System Status Monitor (SSM), also referred to as the Status Monitor Assembly; two drawers containing Power Supplies #1 and #2; and the AT&T Paradyne Data Service Unit (DSU) that provides the profiler 6-minute data link with the Profiler Control Center Hub in Boulder, Colorado. The DSU is Contractor Furnished Equipment (CFE) that is maintained under a contract with AT&T Paradyne Communications.

4.1 RF Generator

As seen in Figure 4-1 and Figure 4-2, the RF Generator is located near the top of the Equipment Cabinet, just below the air filter panel.

The RF Generator Local Oscillator (LO) and Coherent Oscillator (COHO) output two fixed frequency signals used by the profiler receiver. A third 404.37 MHz signal is created by mixing the LO and COHO frequencies to provide the RF Input signal for the radar transmitter.

RF Generator Replacement Procedure

***** WARNING ***** Profiler communications equipment (the DSU) rest on top of the RF Generator behind the air filter panel. Remove the air filter panel above the RF Generator before attempting to pull the RF Generator out from the Equipment Cabinet as shown in photo to right.	

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the air filter panel above the RF Generator from the front of the Equipment Cabinet.

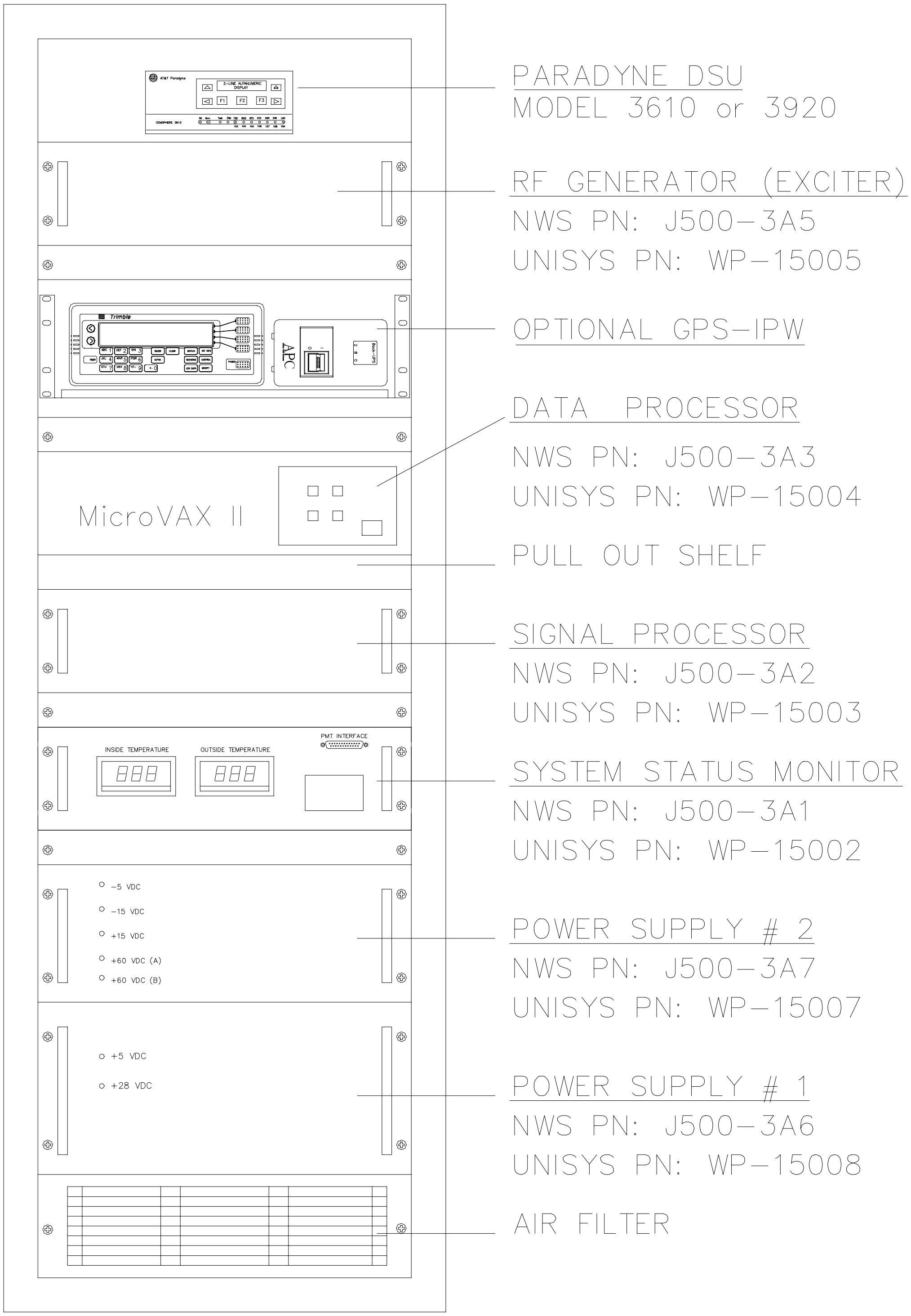


Figure 4-1 Equipment Cabinet Front Panel View

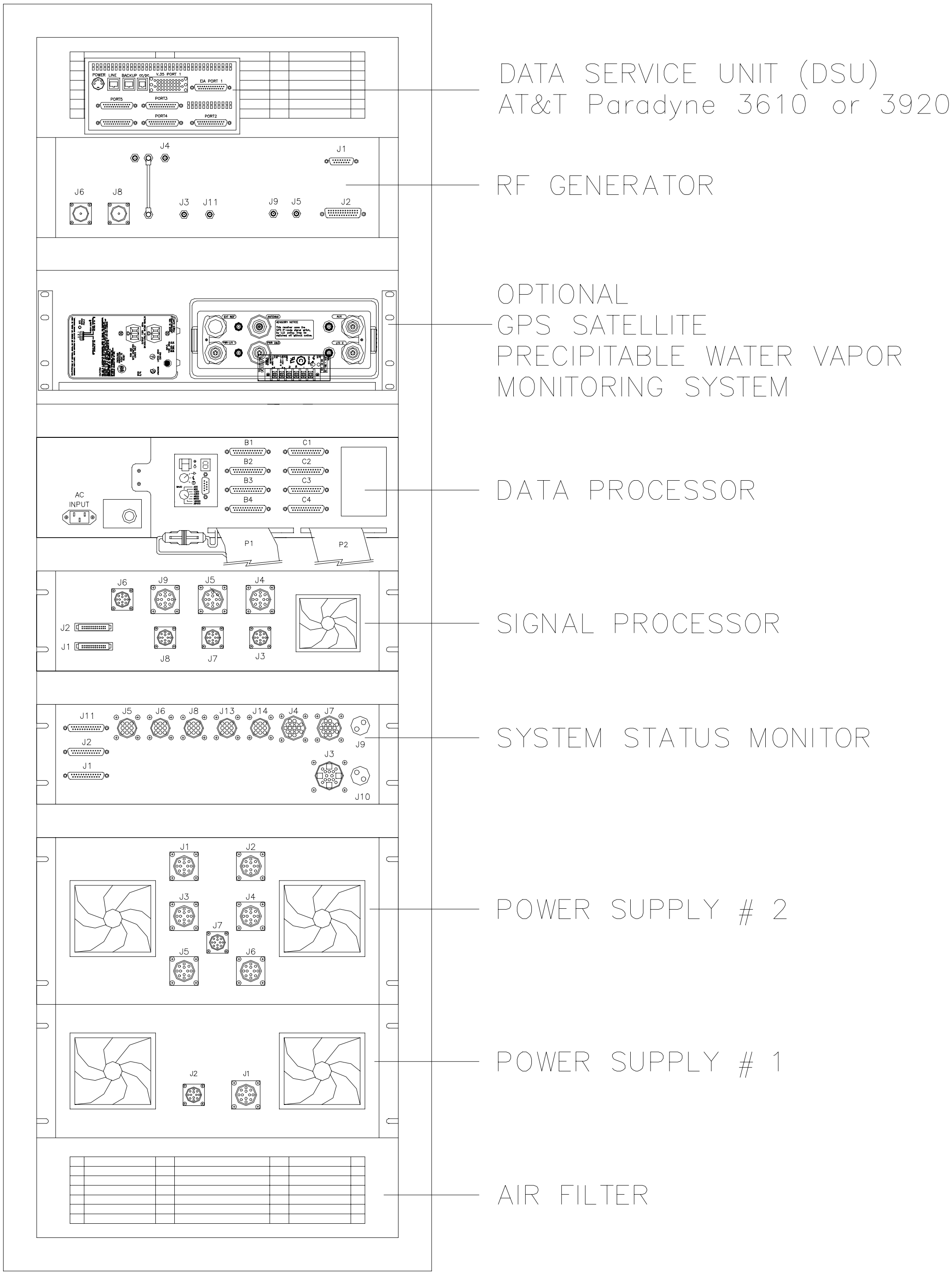


Figure 4-2 Equipment Cabinet Rear Panel View

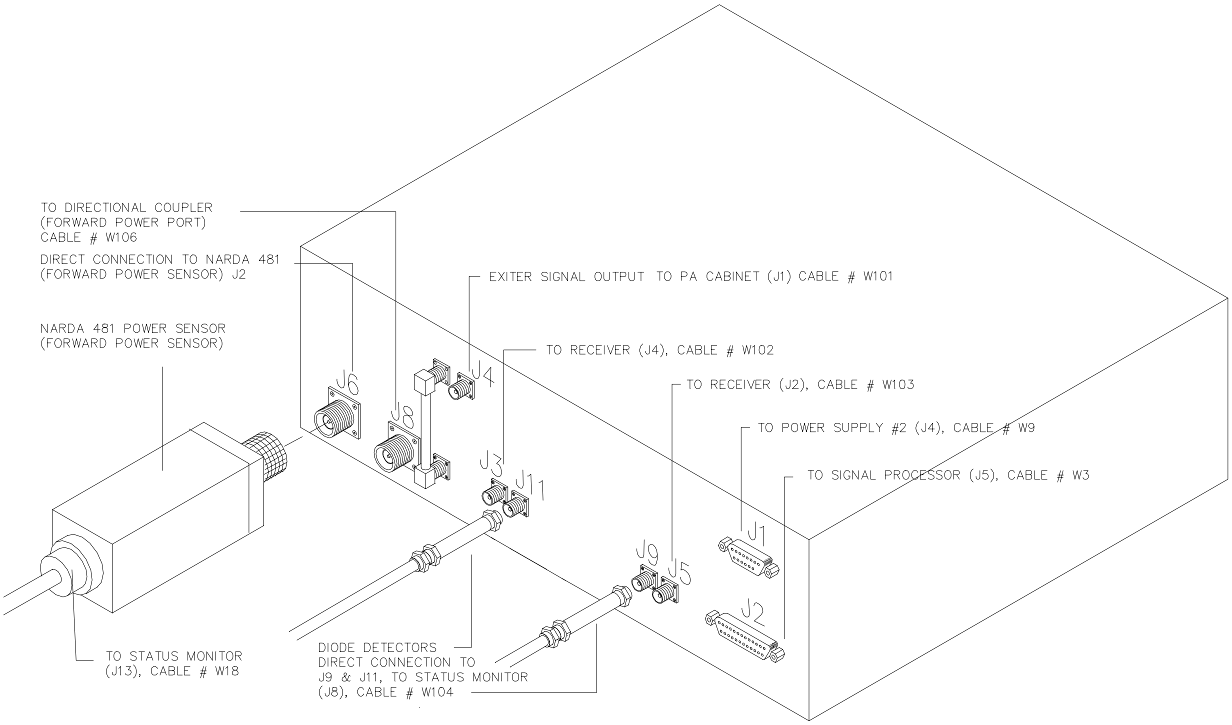


Figure 4-3 RF Generator Rear Panel

3. Remove the four mounting screws from the front panel of the RF generator (see Figure 4-1) and slowly pull the unit to its full-out position.

4. Remove plugs P1 and P2 from connectors J1 and J2 on the rear panel of the RF Generator by depressing the clips on either side of the plugs (see Figure 4-3).

5. Remove the Diode Detectors from J9 and J11; leave them attached to their cables. Note the designations of the cables for future reference.

6. Remove the cables from connectors J3, J4, and J5.

7. Unscrew the type "N" connectors from J6 and J8. Unplug cable #W106 from J8. Remove the forward power sensor from J6.

8. Disengage the slide rails and remove the old RF Generator from the rack with the rails still attached.

9. Remove the slide rails and attach them to the new RF Generator.

10. Install the new unit in the rack.

11. Attach the forward power sensor to J6 and tighten the type "N" connector.

12. Connect cable #W106 to J8 and tighten the type "N" connector.

13. Connect cable #W103 to port J5, cable #W102 to J3, and cable #W101 to J4 and tighten the connections, using a 5/16" wrench if necessary.

14. Reconnect plugs P1 and P2 to ports J1 and J2, and secure the mounting clips.

15. Re-calibrate the Diode Detectors using the diode detector calibration procedure described in Section 4.3.2.

16. Reconnect the Diode Detectors to ports J9 and J11.

17. Carefully slide the unit back into the rack and install the four mounting screws on the front panel.

18. Power up the profiler using the standard power-up sequence described in Section 2.4.

19. Contact the Profiler Control Center at (303) 497-6033 to verify that the RF Generator replacement has been successfully accomplished.

4.2 Forward Power Sensor

The Narda 481 Forward Power Sensor is attached to port J6 of the RF Generator (see Figure 4-3). The sensor monitors the forward power at port J8, which is directly connected to the forward power port of the Directional Coupler in the Beam Steering Unit Cabinet. The sensor converts RF energy to a proportional DC voltage that can be measured by the SSM A/D convertor.

4.2.1 Forward Power Sensor Replacement Procedure

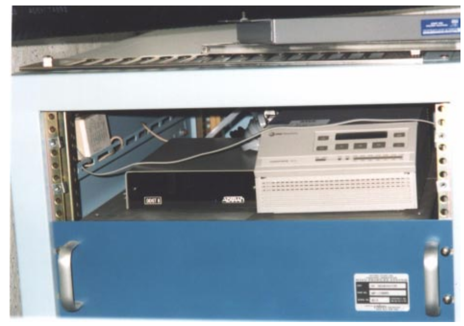
1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the air filter panel above the RF Generator from the front of the Equipment Cabinet.

3. Remove the four mounting screws from the front panel of the RF Generator and pull the unit to its full-out position.

***** WARNING *****

Profiler communications equipment (the DSU) rest on top of the RF Generator behind the air filter panel. Remove the air filter panel above the RF Generator before attempting to pull the RF Generator out from the Equipment Cabinet as shown in photo to right.



4. Disconnect the Forward Power Sensor by unscrewing and removing the type "N" connector from port J6 on the RF Generator back panel (see Figure 4-3).

5. Unscrew and remove the interface-cable connector from the end of the Forward Power Sensor. Use care to prevent Forward Power Sensor interface-cable #W18 from falling to the bottom of the rack since it will be difficult to retrieve in this position.

6. Connect the interface-cable connector to the end of the new sensor, and screw the sensor's type "N" connector into port J6 on the rear panel of the RF Generator.

4.2.2 Forward Power Sensor Calibration

When the Forward Power Sensor is replaced, a calibration must be performed. The calibration is accomplished by setting the zero-offset of the sensor and adjusting the output of the sensor using a peak power meter as the standard.

The steps required to calibrate the Forward Power Sensor include zero-offset adjustment, test equipment setup, power measurement, sensor output calculation, and sensor output calibration. The following test equipment is required:

- HP8491A 10 dB Attenuator
- HP84811A Power Sensor
- HP8900D Peak Power Meter
- Digital Volt Meter (DVM)
- 100 MHZ Oscilloscope
- 2 - BNC (M) to BNC (M) coaxial cables
- Small flat-blade screwdriver

Zero Offset Adjustment

1. Remove the side panel of BSU Cabinet and disconnect the 3-dB pad and coaxial cable from the forward power port on the Directional Coupler (point A in Figure 4-4).

2. Remove the four mounting screws from the front panel of the System Status Monitor and pull the unit to its full-out position. Remove the top cover panel of the SSM.

3. Connect the DVM between test points TP7(+) and TP14(GND) of the Analog Interface Board inside the SSM chassis (see Figure 4-7 for the component layout of the Analog Interface Board).

4. Turn on Breaker #22 to restore power to the Equipment Cabinet.

5. Adjust R23 on the SSM Analog Interface Board for 0 VDC (± 10mV).

6. Turn off Breaker #22 to remove power from the Equipment Cabinet.

Test Equipment Setup

1. Connect one end of the HP8491A 10-dB Attenuator to the HP84811A Power Sensor and the other end to the FWR (forward) power port of the Directional Coupler as illustrated in Figure 4-4.

2. Connect the output cable of the Power Sensor to the SENSOR input of the HP8900D Peak Power Meter (point B in Figure 4-4).

3. Determine the correction factor marked on the HP84811A Power Sensor that is nearest to the 400-MHz range and dial it into the CORRECTION switches on the front panel of the HP8900D Peak Power Meter (point C in Figure 4-4).

4. Set the READING OFFSET on the HP8900D Peak Power Meter to "60 dB", set the MODE to "COMPARE", and the RANGE to "10 mW". If an over range condition occurs during measurements, change the range to "100 mW".

5. Connect the Trigger Output of the HP8900D to the External Trigger Input of an oscilloscope using a BNC (M) to BNC (M) coaxial cable.

6. Connect the Video Output of the HP8900D to Channel One of the Oscilloscope using a BNC (M) to BNC (M) coaxial cable.

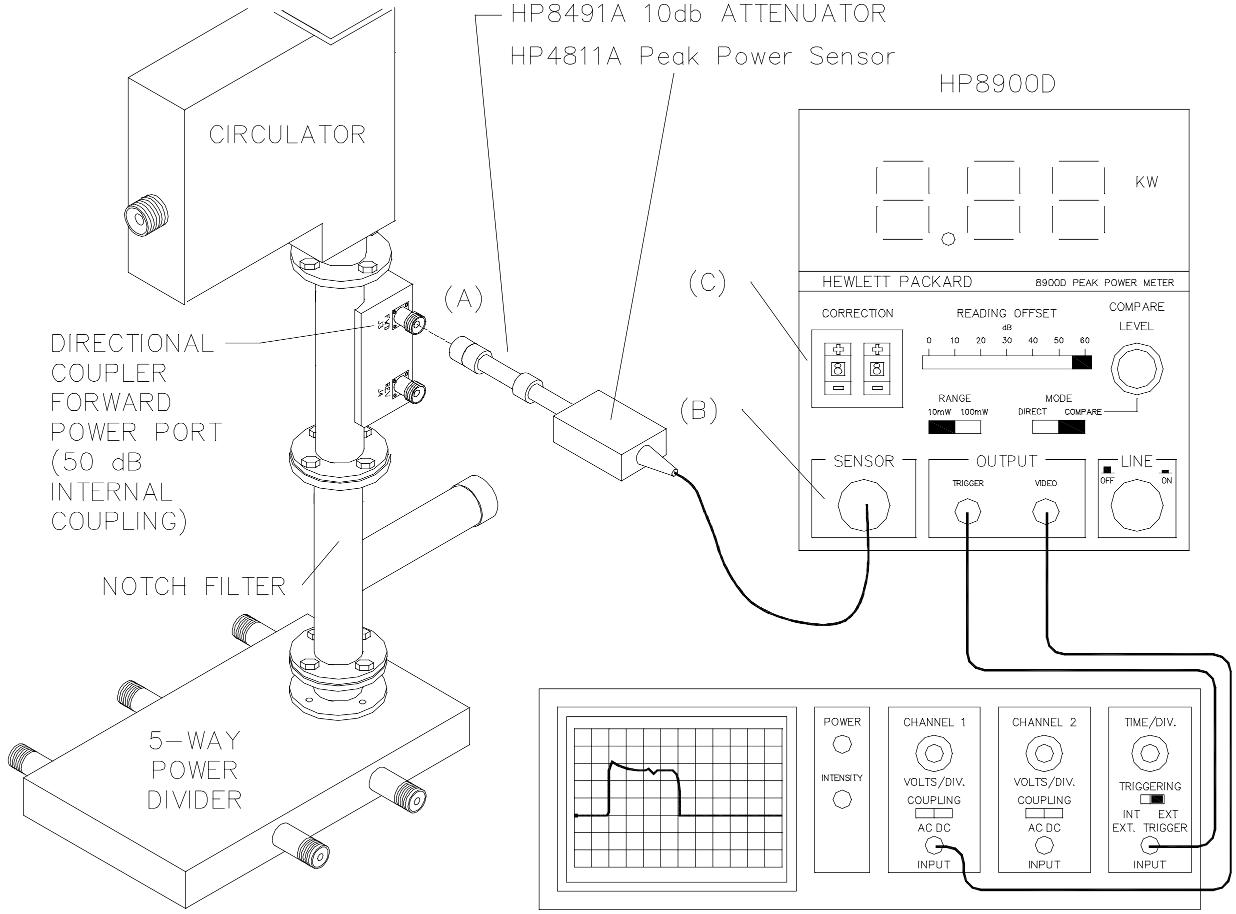


Figure 4-4 Forward Power Sensor Calibration Test Equipment Setup

7. Oscilloscope Settings:

Channel One Volts/Div:	5 mV/Div
Time/Div:	5 s/Div
Trigger:	External
Trigger Edge:	Rising Edge

8. Power up the system by following the standard power-up sequence in Section 2.4.

Power Measurement

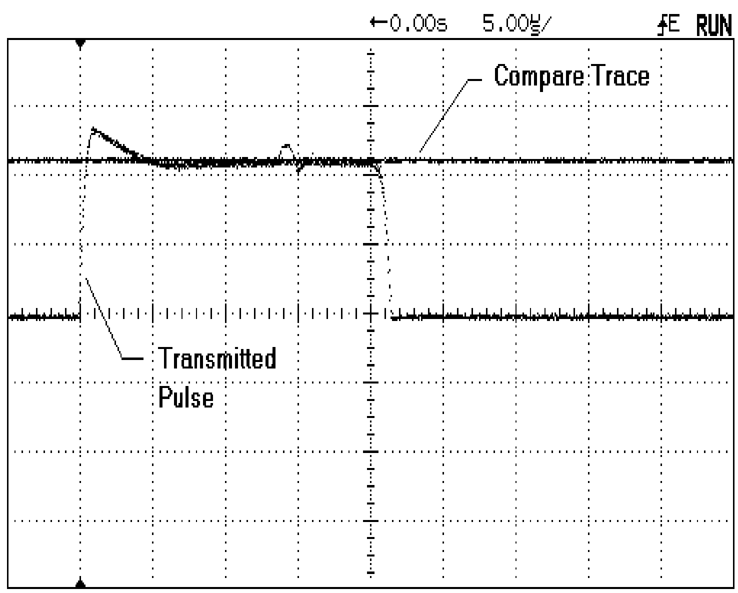
The profiler spends two minutes in each of its three beams (east, north, and vertical): one minute in the high mode and then one minute in the low mode. All power measurements and adjustments must be made in the same beam and mode to ensure the consistency of the measurements.

Observe the front panel of the Beam Steering Unit to determine when the profiler is in a particular beam and mode. When the radar switches beams, one minute remains to make measurements or adjustments in high mode before it switches to low mode using the procedures described below. If measurements or adjustments cannot be made in the selected one minute period, wait until the next time the radar switches into the desired beam and mode.

While the radar is in the beam and mode that has the highest measurable power, observe the waveforms on the oscilloscope. Adjust the *COMPARE LEVEL* knob on the HP8900D to position the *Compare Trace* at the top of the transmitted pulse waveform, averaging through any ripples. Figure 4-5 and Figure 4-6 are examples of transmitted pulses in the high and low modes respectively, the compare traces in these figures have been positioned correctly. Record the peak power value displayed on the HP8900D (referenced below as $P_{measured}$).

Figure 4-5 20 us Peak Power Pulse in High Mode

Waveform displayed on an oscilloscope when used in conjunction with an HP8900D peak power meter. The vertical position of the **Compare Trace** is varied by rotating the *Compare* knob on the HP8900D.



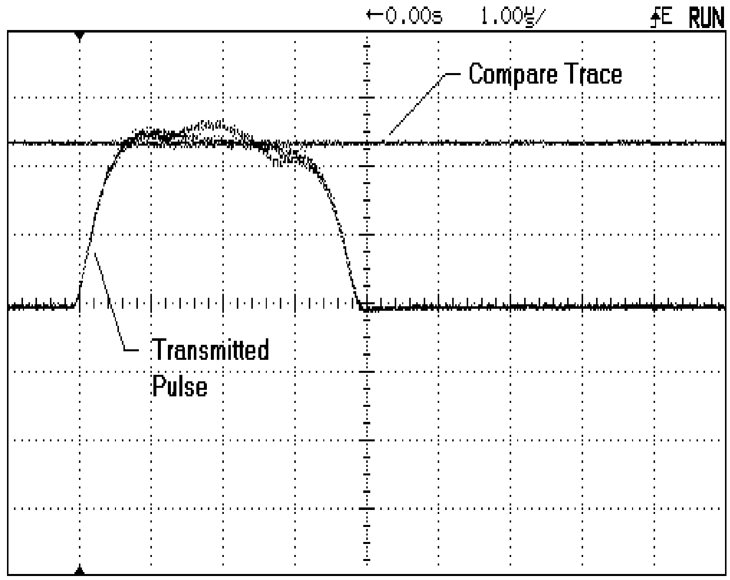
Forward Power Sensor Output Calculation

Calculate the Forward Power Sensor output voltage at a given power level using Equation (4-2) and record the result for later use in the calibration of the sensor.

$$V_{out} = P_{meaured} / 4 \tag{4-1}$$

Figure 4-6 3.33 us Peak Power Pulse in Low Mode

Waveform displayed on an oscilloscope when used in conjunction with an HP8900D peak power meter. The vertical position of the **Compare Trace** is varied by rotating the *Compare* knob on the HP8900D.



where: V_{out} = Forward Power Sensor output voltage measured at TP7(+) of the SSM Analog Interface Board.

$P_{measured}$ = Meter reading of the HP8900D Peak Power Meter

Example: Calculate V_{out} when $P_{meaured}$ = 5.90 KW.

5.90 KW / 4 = 1.475 VDC

Forward Power Sensor Calibration

1. Disconnect the HP84811A Peak Power Sensor and 10 dB Attenuator from the Forward Power port of the Directional Coupler and reconnect the 3-dB pad and coaxial cable #W106.

2. Connect the DVM between TP7(+) and TP14(GND) on the SSM Analog Interface Board located in the chassis of the unit (see Figure 4-7).

3. With the profiler in operational mode and transmitting in the same beam direction and mode that was used to measure the forward power, adjust the calibration potentiometer on the Forward Power Sensor to produce a DC voltage corresponding to the result obtained using Equation (4-1).

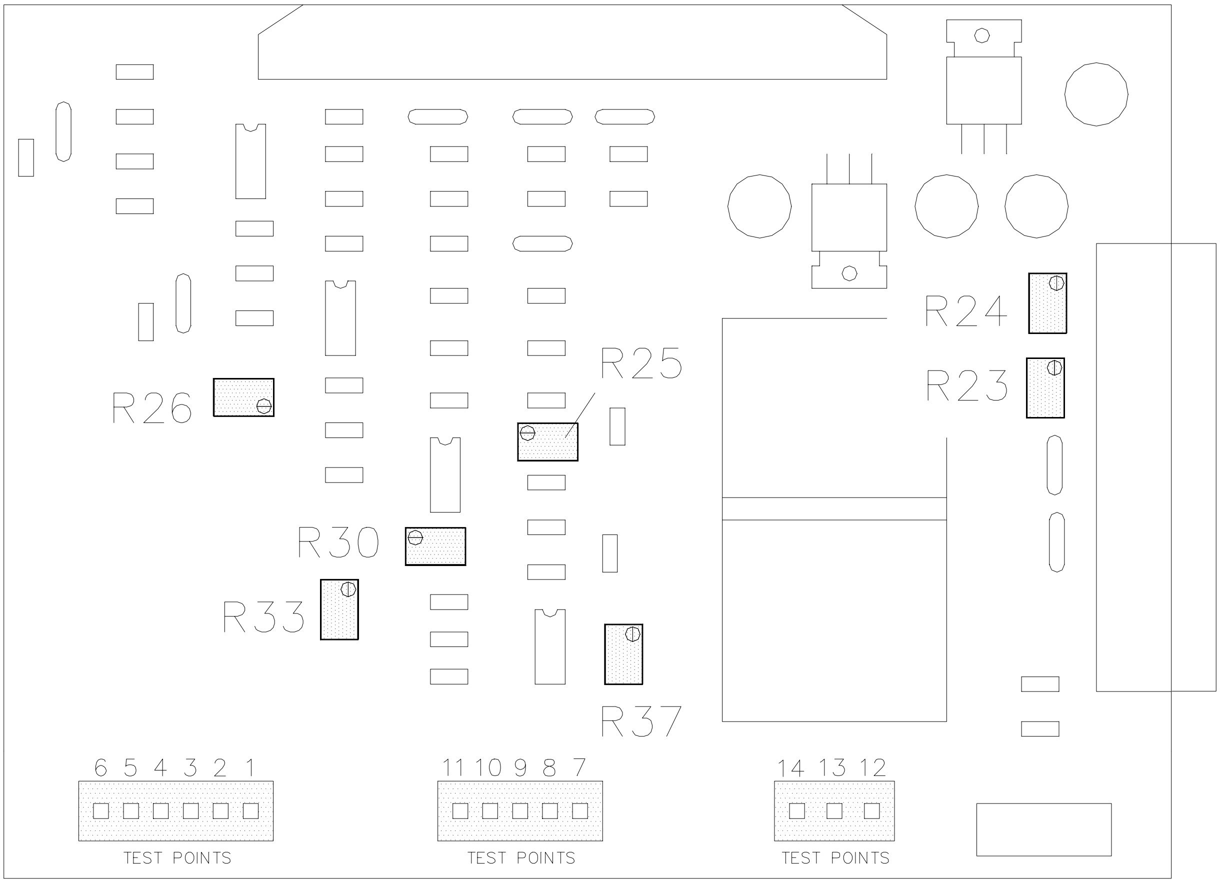


Figure 4-7 Status Monitor Analog Interface Board Component Layout

4. The Forward Power Sensor calibration potentiometer is exposed by removing the metallic plug from the side of the sensor housing (see Figure 4-8). Use a small flat-blade screwdriver to make the adjustment and calibrate the sensor.

Completion Activities

1. Replace the plug on the side of the Forward Power Sensor.

2. Push the RF Generator back into the Equipment Cabinet and replace the four mounting screws on the front panel.

3. Replace the air filter panel above the RF Generator.

4. Replace the top cover of the SSM.

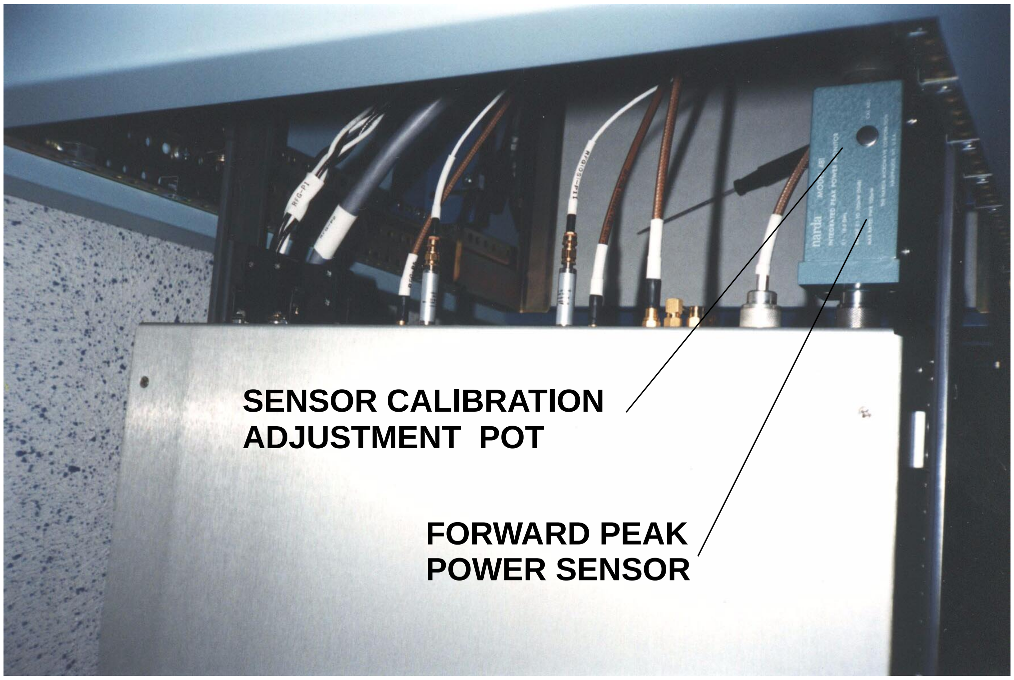


Figure 4-8 Forward Power Sensor Adjustment Potentiometer

5. Push the SSM back into the Equipment Cabinet and replace the mounting screws on the front panel.

6. Contact the Profiler Control Center to verify that the Forward Power Sensor calibration and replacement has been successfully accomplished.

4.3 Diode Detectors

The Diode Detectors, connected to ports J9 and J11 of the RF Generator (see Figure 4-9 and Figure 4-10), rectify LO and COHO RF signals from the RF Generator to produce a proportional DC voltage that is monitored by the SSM to detect RF Generator faults.

4.3.1 Diode Detector Replacement Procedure

1. Follow the standard power-down sequence in Section 2.3.

2. Remove the four mounting screws from the front panel of RF Generator and carefully pull the unit to its full-out position as shown in Figure 4-10.

3. Remove the Diode Detectors from ports J9 and J11 on the rear panel of the RF Generator and note the cable designations for future reference.

4. Remove the Diode Detectors from cables #W104.

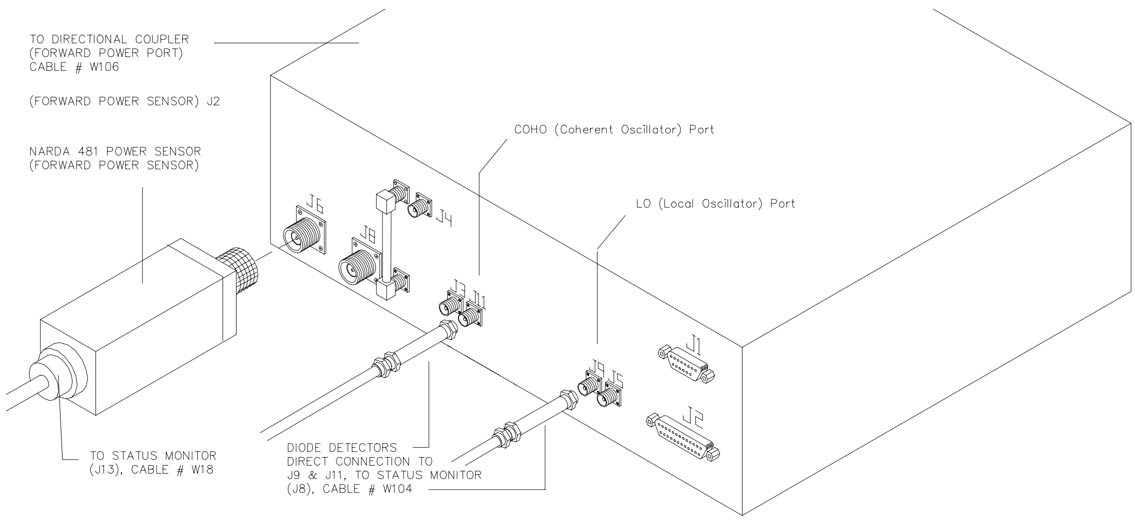


Figure 4-9 Diode Detector Replacement

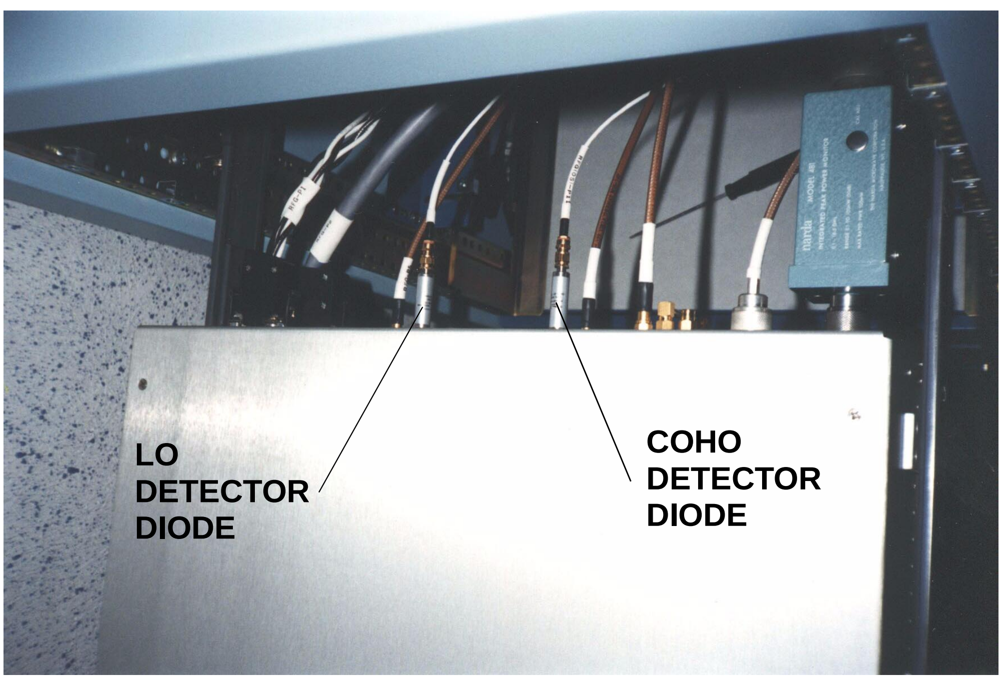


Figure 4-10 RF Generator Detector Diodes

5. Connect the replacement Diode Detectors to cables #W104. Do not reconnect the Diode Detectors to ports J9 and J11 until the "offset" calibration procedures have been completed.

*** CAUTION ***
While the Diode Detectors are disconnected from the RF Generator, make sure the metallic housing of the detectors does not come in contact with any other metallic components such as the rack frame or LRU covers. Isolating the detector housing will prevent erroneous meter readings from occurring during the "offset" calibrations.

4.3.2 Diode Detector Calibration

A Digital Volt Meter (DVM) is required to perform the Diode Detector calibration.

Coherent and Local Oscillator Trip Level Adjustment

1. Remove the four mounting screws from the front panel of the System Status Monitor and carefully slide the SSM to its full-out position. To prevent the cables on the rear panel of the SSM from binding, it may be necessary to slide-out power supply #2 (below the SSM).

2. Remove the top cover panel of the SSM.

3. Turn on Circuit Breaker #22 to return power to the Equipment Cabinet.

4. Connect the ground lead of the DVM to test point TP14(GND) on the SSM Analog Interface Board, and the positive lead to TP10(+). See Figure 4-7 for the location of these test points.

5. Adjust R30 (COHO offset) to produce 0 VDC ± 0.05 VDC.

6. Connect the Diode Detector and cable labeled RFG-P11 to port J11 on the RF Generator.

7. Adjust R26 (COHO gain) to produce 3.75 VDC ± 0.50 VDC.

8. Move the positive lead of the DVM from TP10(+) to TP11(+).

9. Adjust R37 (LO offset) to produce 0 VDC ± 0.05 VDC.

10. Connect the Diode Detector and cable labeled RFG-P9 to port J9 of the RF Generator.

11. Adjust R33 (LO gain) to produce 3.75 VDC ±0.50 VDC.

12. Replace the top cover panel of the SSM, push the unit back into the Equipment Cabinet, and replace the four mounting screws on front panel.

13. Push RF Generator back into the Equipment Cabinet and replace the four mounting screws on the front panel.

14. Turn off Breaker #22 and follow the standard power-up sequence in Section 2.4.

4.4 Data Processor

The Data Processor (DP) Assembly, located above the Signal Processor in the Equipment Cabinet (see Figure 4-11), is built around a Digital Equipment Corporation MicroVax II computer with one megabyte of random access memory (RAM). The Data Processor Assembly also contains the following components:

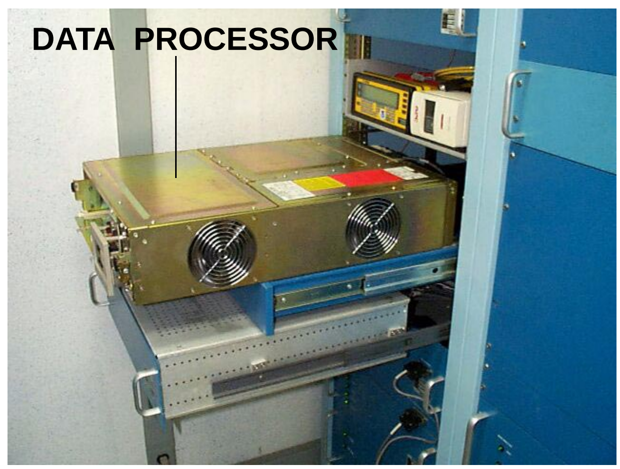


Figure 4-11 Data Processor Location

- An Erasable Programmable Read Only Memory (EPROM) card that contains all programs and system constants (that are transferred to RAM when the system is powered up or rebooted).

- A SKY-320 Digital Signal Processor (hardware Fast Fourier Transform (FFT) card) that performs spectral computations on pulse-compressed time-domain data provided by the Signal Processor.

- An 8-line RS-232 Interface card that provides communication interfaces with various system components including; GOES Communications, DSU Communications, System Status Monitor, Profiler Maintenance Terminal (PMT), and peripheral systems such as the Profiler Surface Observing System (PSOS) and the Radio Acoustic Sounding System (RASS) temperature profiler.

4.4.1 Data Processor Firmware Versions

The functionality of the profiler radar continues to evolve adding new capabilities to the basic system configuration. To accommodate new enhancements, upgrades must be made to the DP firmware. The DP firmware is a set of EPROM chips located on the EPROM board inside the Data Processor (see Figure 4-15 for location). There are two different versions of Data Processor firmware currently in use. Appendix E provides the current distribution of firmware versions at all network profiler sites. The basic differences between the firmware versions are described below in Table 4-1.

***** IMPORTANT *****

When a DP is ordered out of spares stock from Kansas City, the DP is shipped with **Version 8.2** firmware. If a DP is replaced at a site that is equipped with RASS, the EPROM cards in the *original and replacement DP must be interchanged* to ensure that Version 9 firmware stays with the site. Figure 4-12 and Figure 4-13 show the PC board layout, jumper settings, and chip configurations for version 8.2 and 9 EPROM cards.

Table 4-1 Data Processor Firmware Versions

Firmware Version	Status	Notes about Firmware Version
Version 3	Obsolete 404 MHz	Previous base-line configuration firmware. **Not Y2K Compliant.**
Version 4	Obsolete 404 MHz	Adds sea-clutter removal capabilities to the signal processing. **Not Y2K Compliant.**
Version 6	Obsolete 404 MHz	Adds RASS capabilities to the profiler configuration. **Not Y2K Compliant.**
Version 8.2	Active 404 MHz	Current Baseline Firmware Version for 404 MHz Profiler Systems without RASS Option
Version 9	Active 404 MHz With RASS	Current Baseline Firmware Version for 404 MHz Profiler Systems with RASS Option
Version 10	Prototype 449 MHz	Prototype Baseline Firmware Version for 449 MHz Profiler Systems without RASS Option
Version 11	Prototype 449 MHz With RASS	Prototype Baseline Firmware Version for 448 MHz Profiler Systems with RASS Option

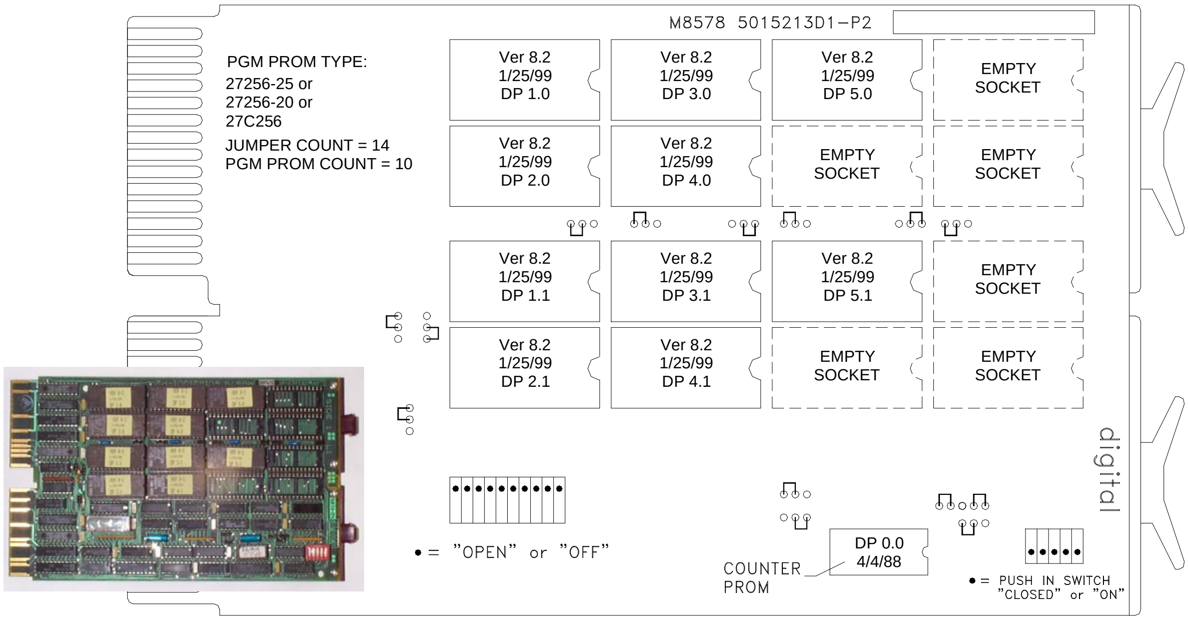


Figure 4-12 Version 8.2 Data Processor EPROM Board Configuration

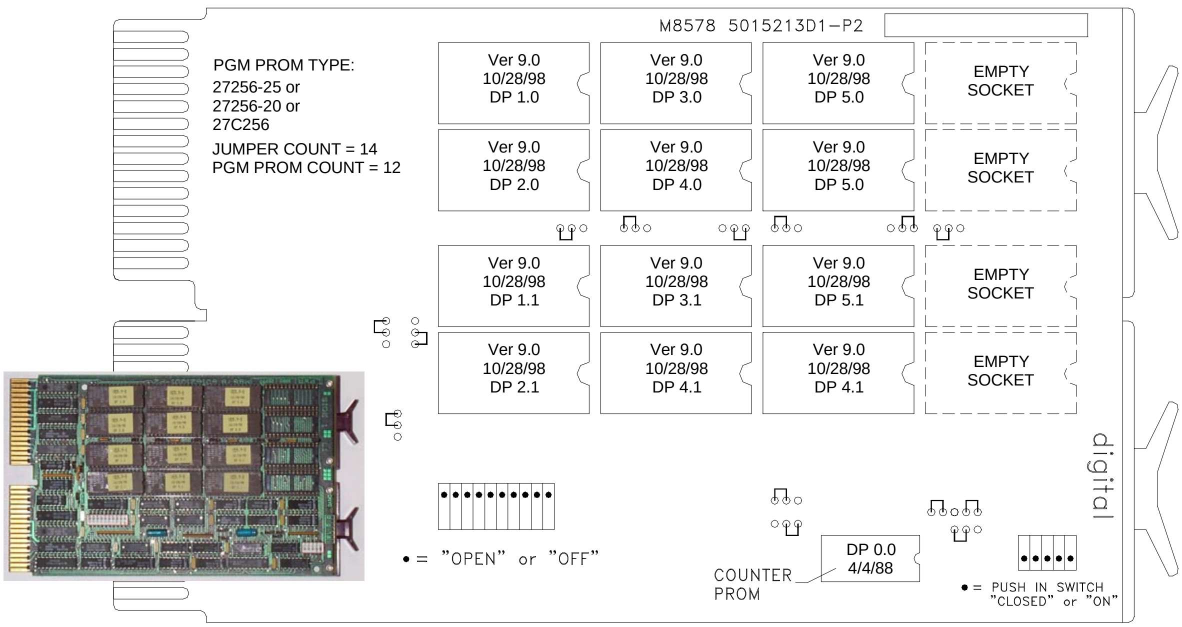


Figure 4-13 Version 9.0 Data Processor EPROM Board Configuration

4.4.2 Data Processor Replacement

Data Processor Removal Procedure

***** NOTE *****

When the Data Processor is pulled to its full-out position, its only means of support is the pull-out shelf directly below it. Be sure to pull out the shelf before extracting the Data Processor.

Because of the physical configuration of the interface cables between the Data Processor and the Signal Processor, the two units must be pulled out of the Equipment Cabinet in concert as shown in Figure 4-11.

1. Follow the standard power-down sequence in Section 2.3.

2. Remove the four mounting screws from the front panel of the Signal Processor.

3. Remove the front cover of the Data Processor and remove the mounting screws from the unit.

4. Pull the shelf from beneath the Data Processor to its full-out position while concurrently pulling the Signal Processor and Data Processor to their full-out positions. Note that the Data Processor should be resting on the shelf below.

5. Disconnect ribbon cables P1 and P2 from ports J1 and J2 on the rear panel of the Signal Processor. Reach behind the Data Processor and pull the ribbon cables out, draping them over the top of the Data Processor.

6. Verify that each RS-232 cable designation is clearly marked as referenced in Figure 4-14. If a designation is absent, note the point of connection between the cable and the Data Processor.

7. Using a small flat-blade screwdriver, loosening the retaining screws on both sides of connectors B1, B3, B4, C1, and C2.

8. Unplug the AC power cord from the rear of the Data Processor.

9. Remove the old Data Processor from the shelf.

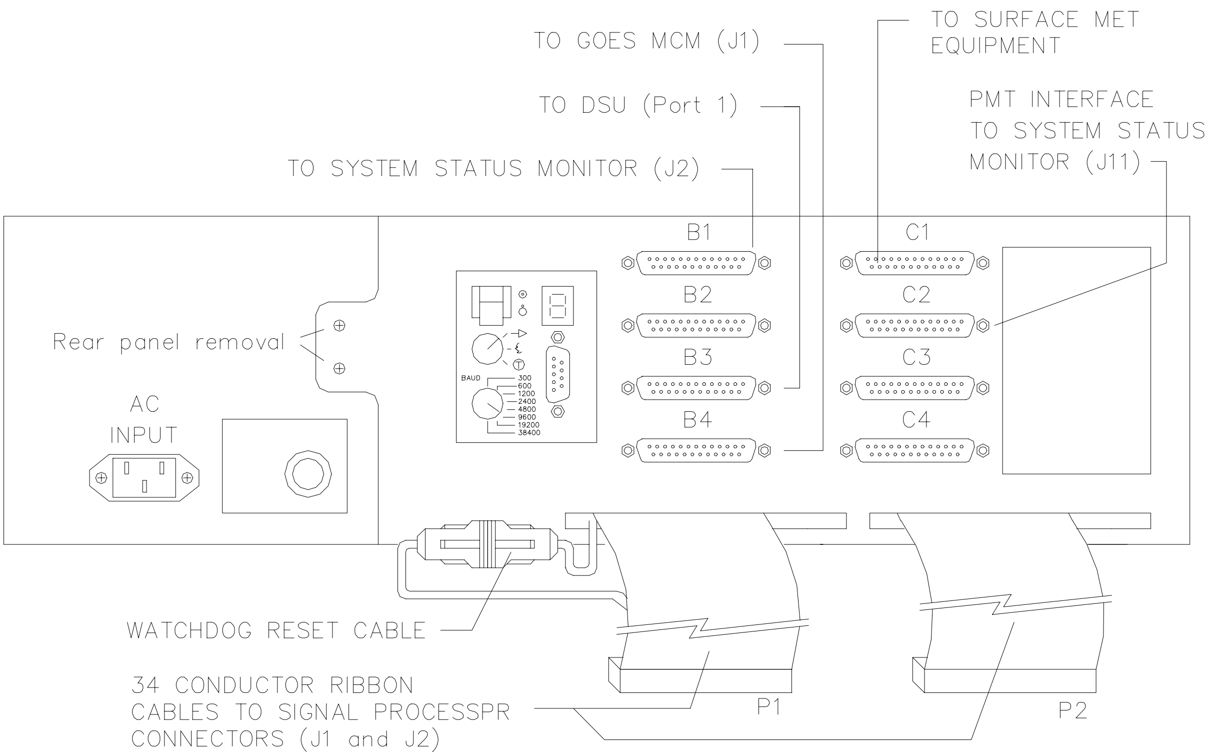


Figure 4-14 Data Processor Rear Panel and Cable Connections

Data Processor Installation Procedure

> ***** NOTE *****
>
> The circuit cards housed in the Data Processor card cage can become dislodged or improperly seated during shipping. Prior to installing a new Data Processor, it is necessary to remove the rear panel from the Data Processor and re-seat all cards in the card cage.

1. Place the new Data Processor on the Equipment Cabinet shelf with the rear panel facing you.

2. Remove the two screws labeled "Rear Panel Removal" (as shown in Figure 4-14) and remove the back panel of the Data Processor by swinging the panel outward to disengage the hinge on the right side. Lay the rear panel flat to expose the

card cage containing the Data Processor circuit cards. Refer to Figure 4-15 for layout of the card cage.

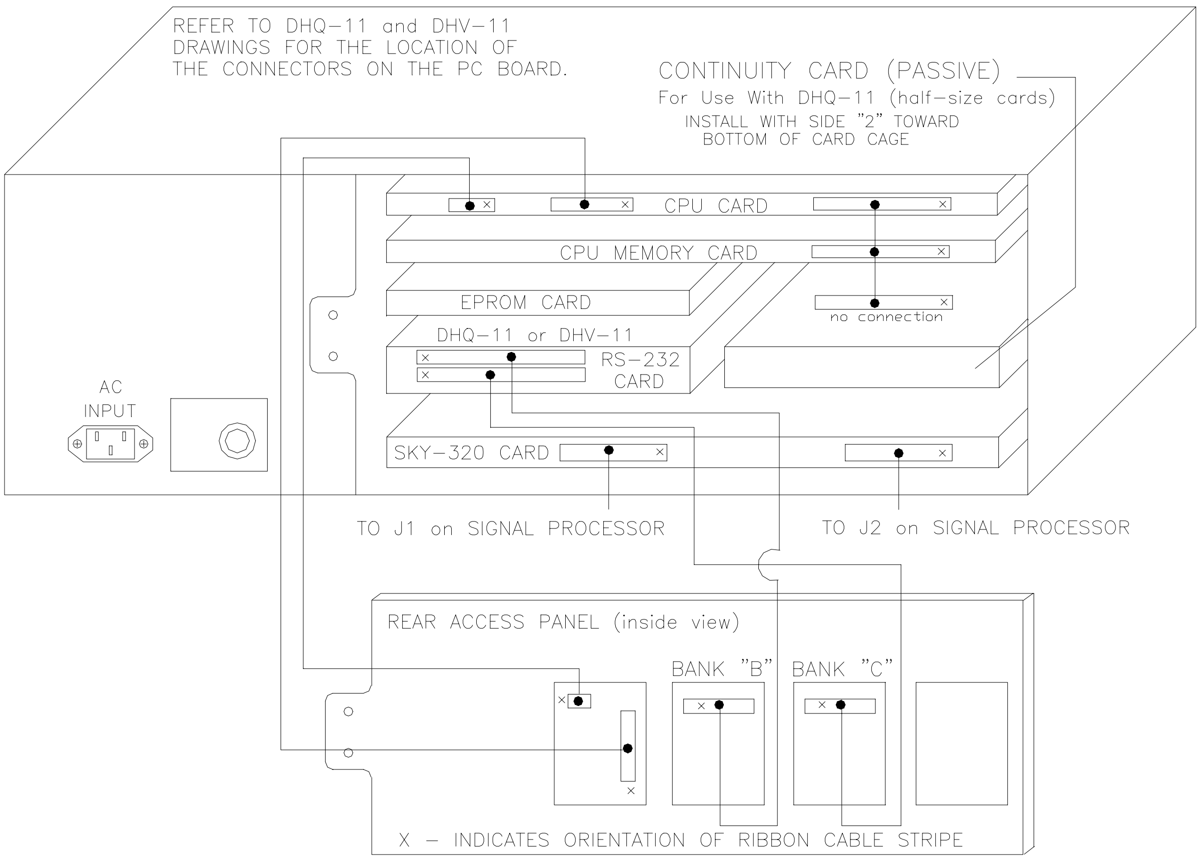


Figure 4-15 Data Processor Card Cage Layout

***** CAUTION *****

The circuit cards in the DP can be damaged by STATIC ELECTRICITY! Always exercise anti-static precautions and, if possible, use an anti-static mat and wrist strap when handling these cards.

3. If the site firmware is version 9 (RASS), remove the EPROM card from the old unit and install the card in the replacement DP. When seating the EPROM card, make sure it remains firmly against the left guide of the card cage

4. Partially remove the full-size cards by disengaging the locking mechanisms on the ends of the cards and re-seat them firmly. Partially remove half-size cards (without locking mechanisms), and re-seat them to ensure that the left side of each card is firmly against the guides on the left side of the card cage (as shown in Figure 4-15).

5. Inspect all ribbon cable connectors to ensure that they are properly seated.

6. Replace the Data Processor rear panel and tighten the retaining screws.

7. Verify that the switch settings on the rear panel match those in Figure 4-16.

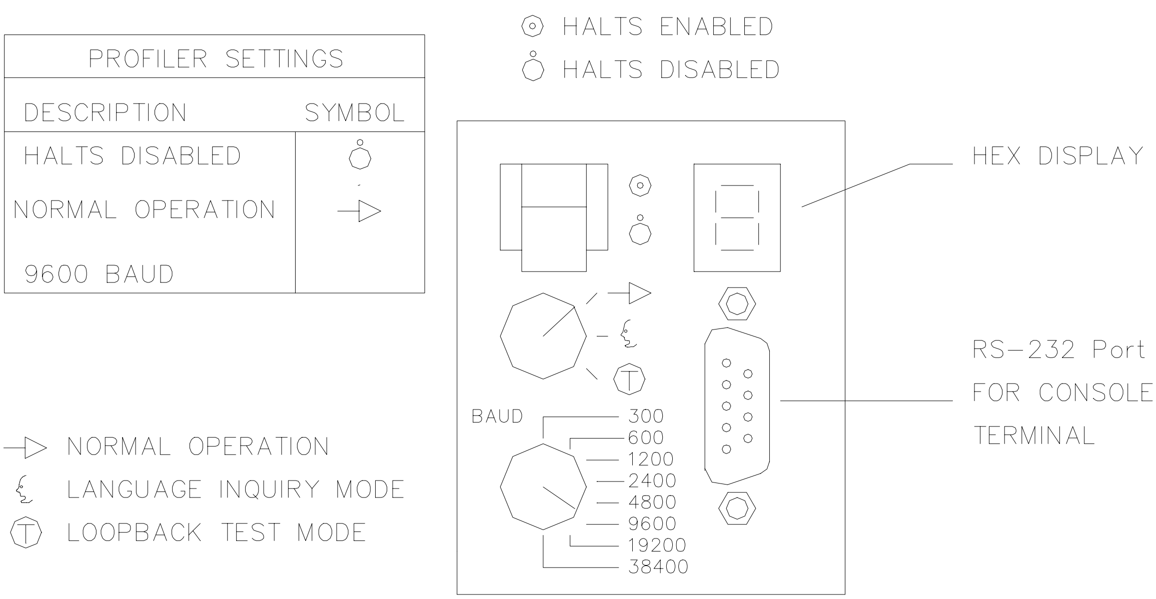


Figure 4-16 Data Processor Rear Panel Switch Settings

8. Turn the Data Processor so that the rear of the unit faces the Equipment Cabinet. Feed ribbon cables P1 and P2 down to the rear of the Signal Processor and reconnect them to ports J1 and J2.

9. Reconnect cables B1, B3, B4, C1, and C2 to their respective connectors (see Figure 4-14) and ensure that the retaining screws on both sides of the connectors are tightened properly.

10. Plug the AC power cord in to the rear panel of the Data Processor.

11. Turn on Breaker #24 and observe the hexadecimal display on the rear panel of the Data Processor (see Figure 4-16). A countdown sequence (starting on

hexadecimal digit F and ending on 0) should appear as the Data Processor boots up.

A display of 0 indicates that the Data Processor has booted successfully. If the countdown terminates before reaching zero, refer to Table 4-2 for the diagnostic message corresponding to the hexadecimal termination value. Try rebooting the Data Processor or contact the Profiler Control Center for assistance.

12. Turn off Breaker #24 to remove power from the Equipment Cabinet.

13. Slide the Data Processor and Signal Processor into position within the Equipment Cabinet and secure them with their mounting screws.

14. Replace the front cover of the Data Processor.

15. Follow the standard power-up sequence in Section 2.4.

16. Contact the Profiler Control Center at (303) 497-6033 to verify that the Data Processor replacement has been successfully accomplished.

Table 4-2 Data Processor Hexadecimal Diagnostic Display

Code	Description	Code	Description
F	Waiting for DC	**7**	Running data tests on RAM
E	Waiting for Processor	**6**	Running address test on RAM
D	Running checksum test on CPU ROM	**5**	Running tests that use Q22 bus to access local memory
C	Searching for RAM memory	**4**	CPU instruction and register tests
B	Read KA630-Z IPCR register	**3**	Running interrupt tests
A	Testing video console (if present)	**2**	Searching for bootstrap device
9	Identifying console terminal	**1**	Bootstrap device found
8	Language inquiry of CPU halted	**0**	Testing completed

4.4.3 8-Line RS-232 Interface Card Replacement

This component has been identified as a high failure item within the Data Processor Assembly Line Replaceable Unit (LRU). Under certain circumstances, it is desirable to replace this component without replacing the entire LRU.

There are two versions of the interface card that are functionally identical but physically dissimilar. These are designated Models DHV-11 and DHQ-11, the older and newer version, respectively. Refer to Figure 4-17 and Figure 4-18 for the layout and DIP switch settings for these cards. The DHV-11 is a full-width card, and the DHQ-11 is half-width card. The DHQ-11 card requires the installation of a passive Continuity card to operate. Refer to Figure 4-15 for the installed location of the Continuity card. The Continuity card has no active circuitry, but provides circuit traces which route necessary bus signals on back-plane of the card cage.

8-Line RS-232 Interface Card Removal Procedure

1. Remove the 8-Line RS-232 Interface Card by following steps 1-9 in the Data Processor Removal Procedure and steps 1-2 in the Data Processor Installation Procedure.

> ***** CAUTION *****
>
> When removing or installing model DHQ-11 RS-232 cards, take care not to let the interface cables (ribbon cables) insulation get scratched by the soldered component legs on the bottom of circuit board above the DHQ-11 in the card cage.

2. Locate and remove the RS-232 Interface Card from the card cage (see Figure 4-15).

3. Disconnect the ribbon cables from the interface card.

8-Line RS-232 Interface Card Installation Procedure

1. Configure the DIP switches on the new card as indicated in Figure 4-17 or Figure 4-18, as appropriate.

2. Reconnect the ribbon cables to the new interface card taking care to re-install the cables in their proper locations on the card. Refer to Figure 4-15 to identify Bank "B" and "C" cables.

3. Reinstall the RS-232 Interface Card in the card cage ensuring that the left side of the card is firmly seated against the guides on the left side of the card cage.

4. Reinstall the rear panel in the Data Processor by engaging the hinge on the right side of the panel and rotating it inward. Replace the screws at the point marked "Rear Panel Removal" (see Figure 4-14).

5. Follow steps 7-14 in the Data Processor Installation Procedure.

6. Contact the Profiler Control Center at (303) 497-6033 to verify that the 8-Line RS-232 Interface Card replacement has been successfully accomplished.

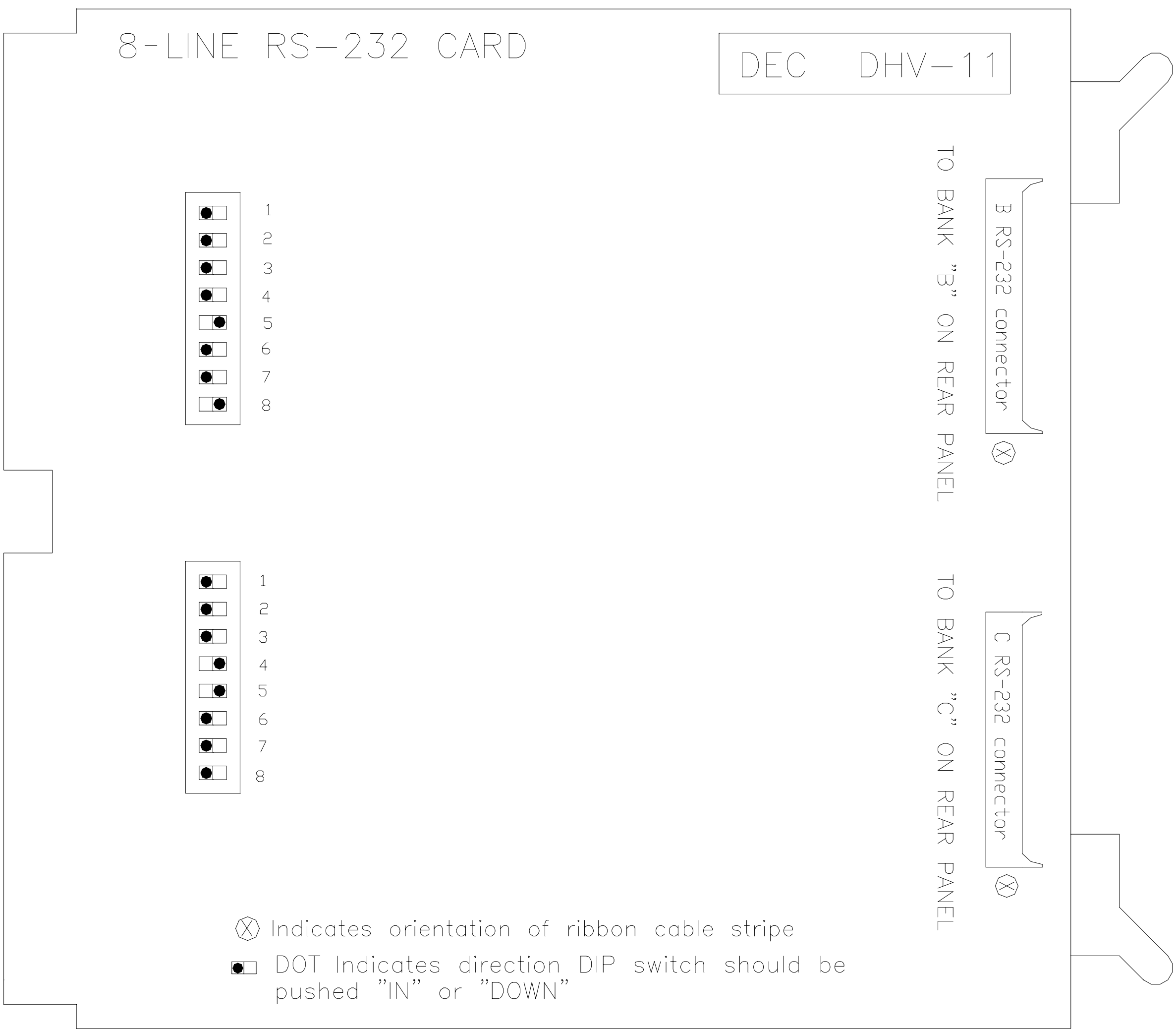


Figure 4-17 Model DHV-11 8-Port RS-232 Interface Card

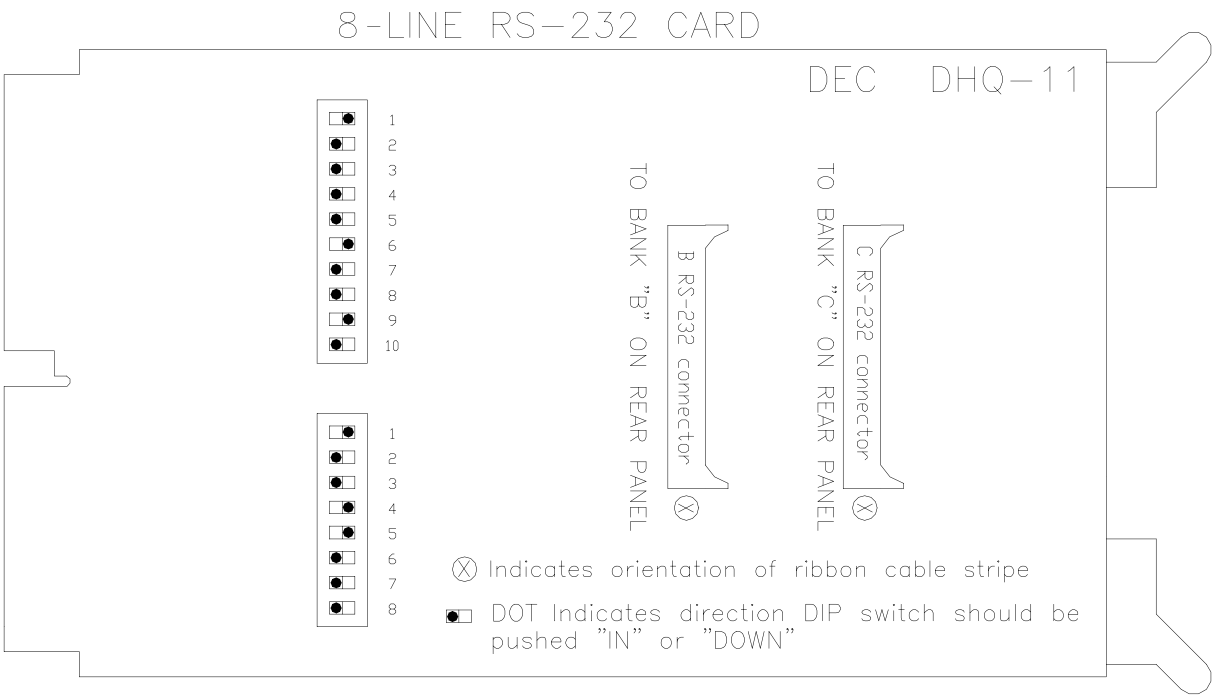


Figure 4-18 Model DHQ-11 8-Port RS-232 Interface Card

4.4.4 Erasable Programmable Read-Only Memory Card Replacement

Occasional upgrades to the software in the EPROM will require replacement of the EPROM card. The following procedures describe replacement of this card.

EPROM Card Removal Procedure

1. To replace the EPROM Card, follow steps 1-9 in the Data Processor Removal Procedure, and steps 1-2 in the Data Processor Installation Procedure. EPROM Card.

2. Locate and remove the EPROM Card from the card cage (see Figure 4-15).

EPROM Card Installation Procedure

1. Install the new EPROM Card in the card cage ensuring that the left side of the card is firmly seated against the guides on the left side of the card cage.

2. Reinstall the rear panel in the Data Processor by engaging the hinge on the right side of the panel and rotating it inward. Replace the screws at the point marked "Rear Panel Removal" (see Figure 4-14).

3. Follow steps 7-14 in the Data Processor Installation Procedure.

4. Contact the Profiler Control Center to verify that the EPROM Card replacement has been successfully accomplished.

4.5 Signal Processor

The Signal Processor is located between the Data Processor and the System Status Monitor in the Equipment Cabinet (see Figure 4-19). It performs high speed data processing of the signals generated by the Receiver, and transmits master timing and control signals to various profiler subsystems.

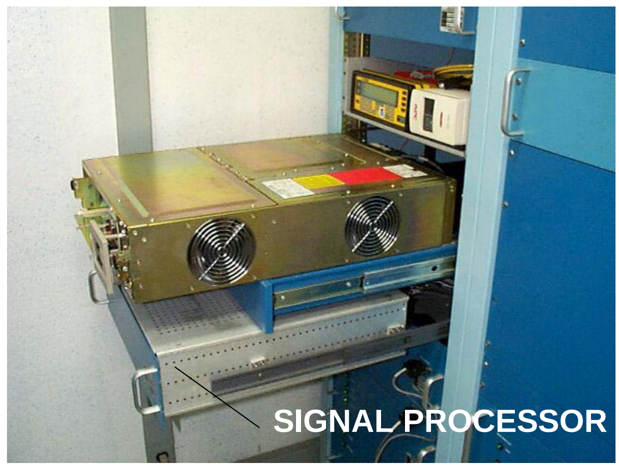


Figure 4-19 Signal Processor Location

An important element of the Signal Processor is the "Watchdog Timer" reset circuit. The Watchdog Timer reboots the Data Processor when any one of the following conditions occur:

- Data Processor "hangs up" due to a fatal error in the software.
- Voltage Standing Wave Ratio (VSWR) fault is detected by the SSM.
- Beam Steering Unit (BSU) fault is detected by the SSM.

If any error occurs four consecutive times, the Watchdog Timer will not attempt to reboot the Data Processor. Under these circumstances, the Data Processor must be rebooted manually using the Profiler Maintenance Terminal (PMT) or, if "hard hung", by power cycling the system.

The Signal Processors internal circuit board is mounted on hinged strand-offs (see Figure 4-20). During shipping, these stand-offs supporting the circuit board can become loose or even dislodged, creating the potential for the circuit board to short-out on the chassis. As a general rule, always perform a visual inspection of the replacement Signal Processor's internal components prior to installation. Verify the circuit board is mounted securely and that all connectors are seated properly.

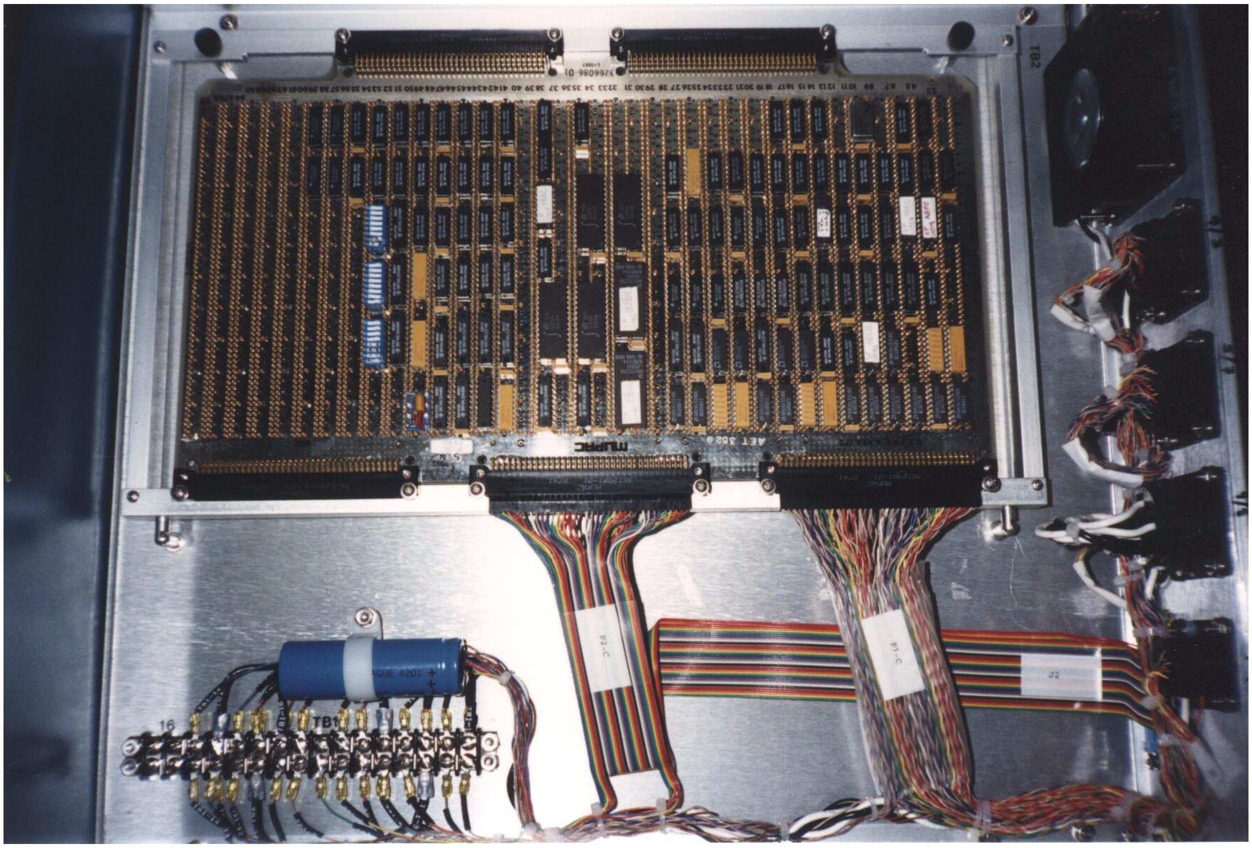


Figure 4-20 Signal Processor Internal Component Layout

Signal Processor Replacement

1. Follow the standard power-down sequence in Section 2.3.

2. Remove the four mounting screws from the front panel of the Signal Processor and carefully pull the unit to its full-out position. Because of the arrangement of cables connecting the Signal Processor and Data Processor, it may be necessary to pull out the Data Processor and the shelf above it to gain sufficient access to the rear of the unit.

3. Unplug ribbon cables P1 and P2 from ports J1 and J2. Loosen the retaining nuts on plugs P3-P9, and disconnect them from ports J3-J9 on the rear panel of the Signal Processor (see Figure 4-21).

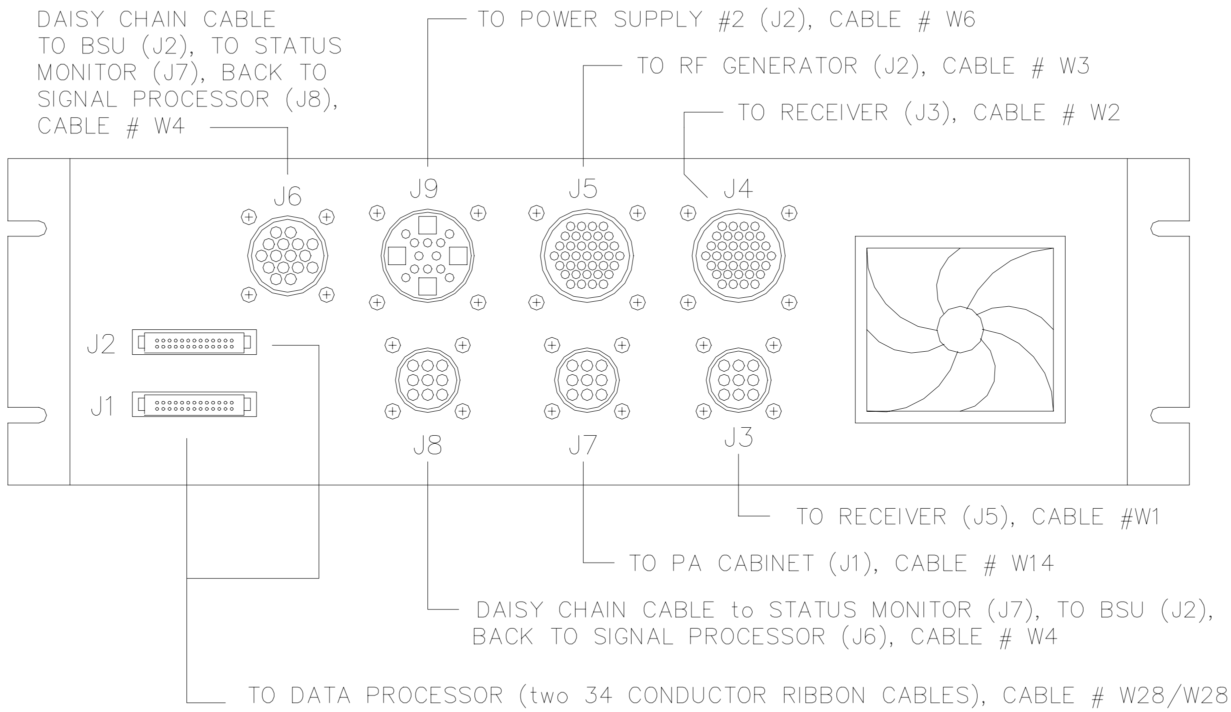


Figure 4-21 Signal Processor Rear Panel and Cable Connections

4. Disengage the slide rails from the unit and remove the Signal Processor from the Equipment Cabinet. Remove the slide rails from the old Signal Processor and transfer them to the new unit.

5. Insert the new Signal Processor into the Equipment Cabinet and engage the slide rails into their tracks.

6. Reach behind the Signal Processor, retrieve ribbon cables P1 and P2, plug them into ports J1 and J2, reconnect cables P3-P9 to J3-J9. Tighten the retaining nuts.

7. Slide the Signal Processor back into the Equipment Cabinet and replace the four mounting screws on the front panel. Return the Data Processor and shelf to their original positions.

8. Follow the standard power-up sequence in Section 2.4.

9. Contact the Profiler Control Center to verify that the Signal Processor replacement has been successfully accomplished.

4.6 System Status Monitor

The System Status Monitor (SSM) is located in the Equipment Cabinet between the Signal Processor and Power Supply #2 (see Figure 4-22). It is responsible for monitoring the environment of the Shelter Assembly and the status of critical profiler Line Replaceable Units. The SSM is comprised of an Intel Single Board Computer (SBC) with an Analog Multiplexer daughter board, two integrated temperature meters, a digital interface board, and an analog interface board. The internal component layout of the SSM is shown in Figure 4-23, and an interface diagram of the SSM is presented in Figure 4-24.

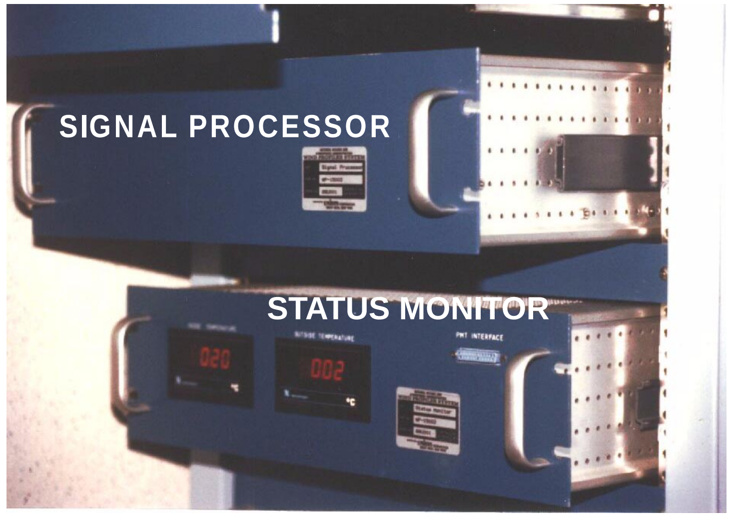


Figure 4-22 Status Monitor Location

4.6.1 Intel Single Board Computer (SBC)

The SSM is build around the Intel model iSBC 186/03A Single Board Computer. The Intel SBC operates under a stand-alone program that regulates the shelter environment independently from Data Processor control. The SBC measures analog voltages and processes digital I/O routed through the Analog and Digital Interface cards. The Intel SBC communicates processed status information to the Data Processor via RS-232 interface.

The Intel SBC contains two EEPROM chips (type 2864) that store critical site-specific parameters, a log of LRU failure information, and the Search and Rescue Satellite (SARSAT) turn-off schedules. Figure 4-25 shows that component layout of the Intel SBC and locations of the two EEPROMs (U43 and U76).

The System Status Monitor's internal components can become dislodged during shipping. Prior to installing a replacement unit, always remove the top cover panel and perform a visual inspection for mechanical integrity and verify that all internal cable connectors are seated properly.

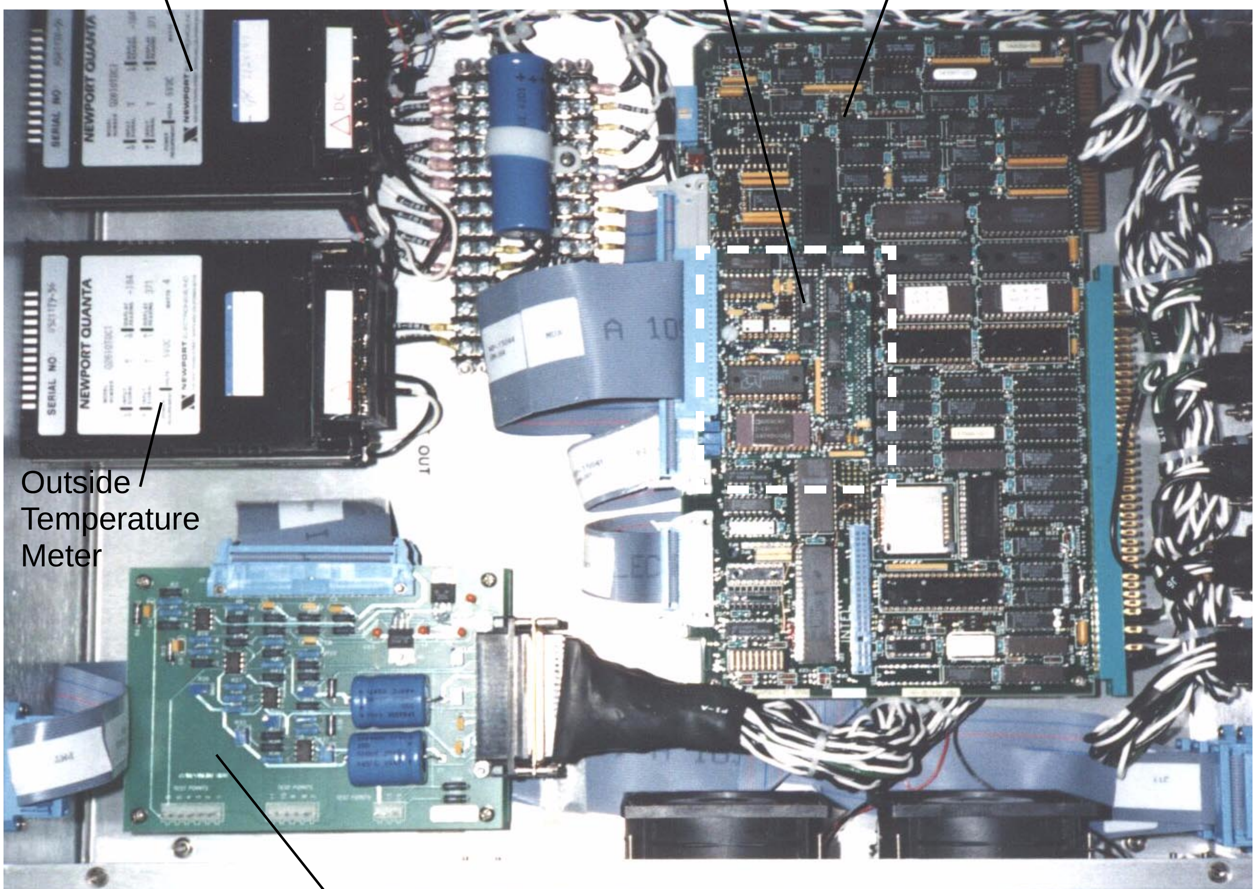


Figure 4-23 Status Monitor Internal Component Layout

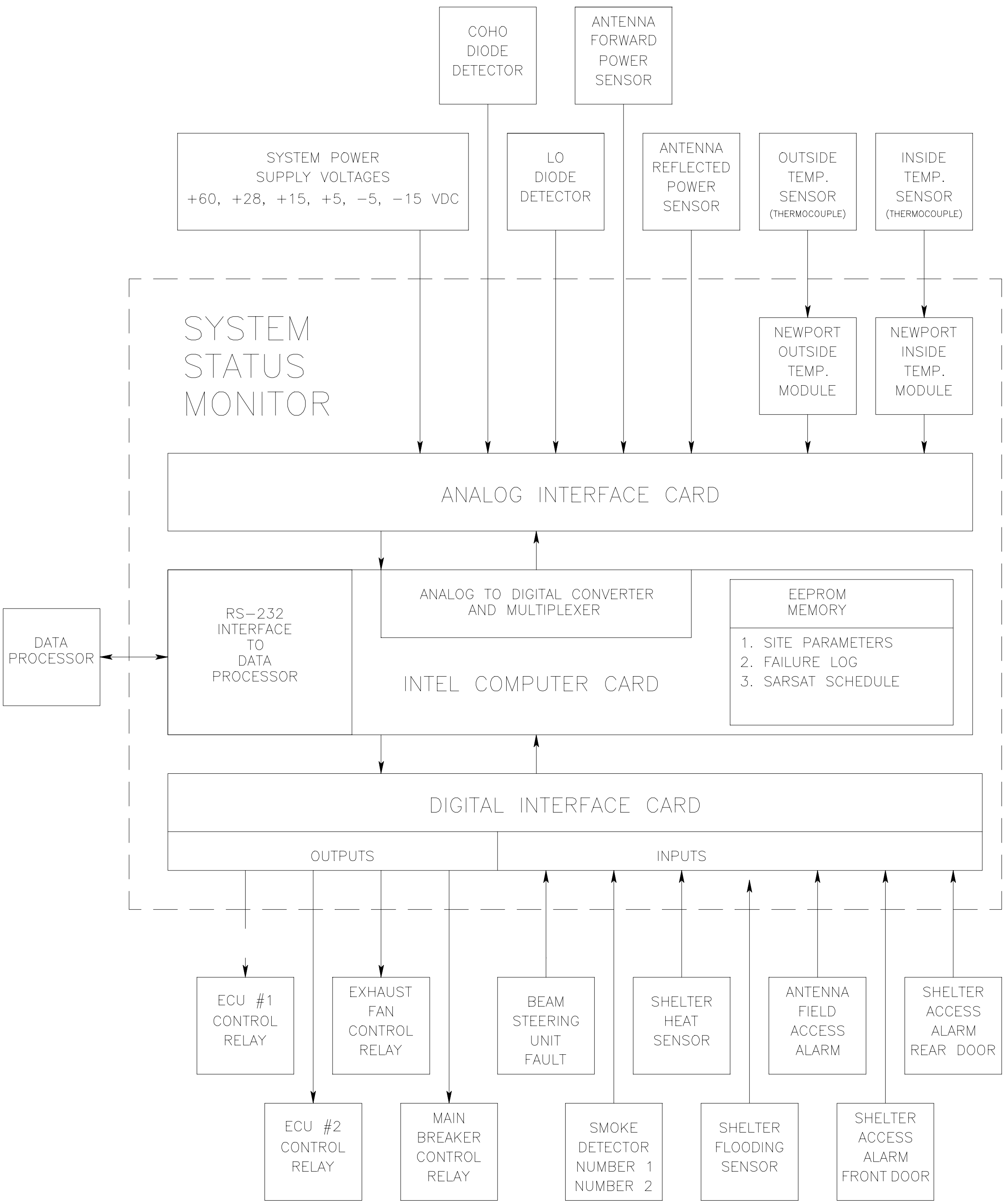


Figure 4-24 Status Monitor Interface Diagram

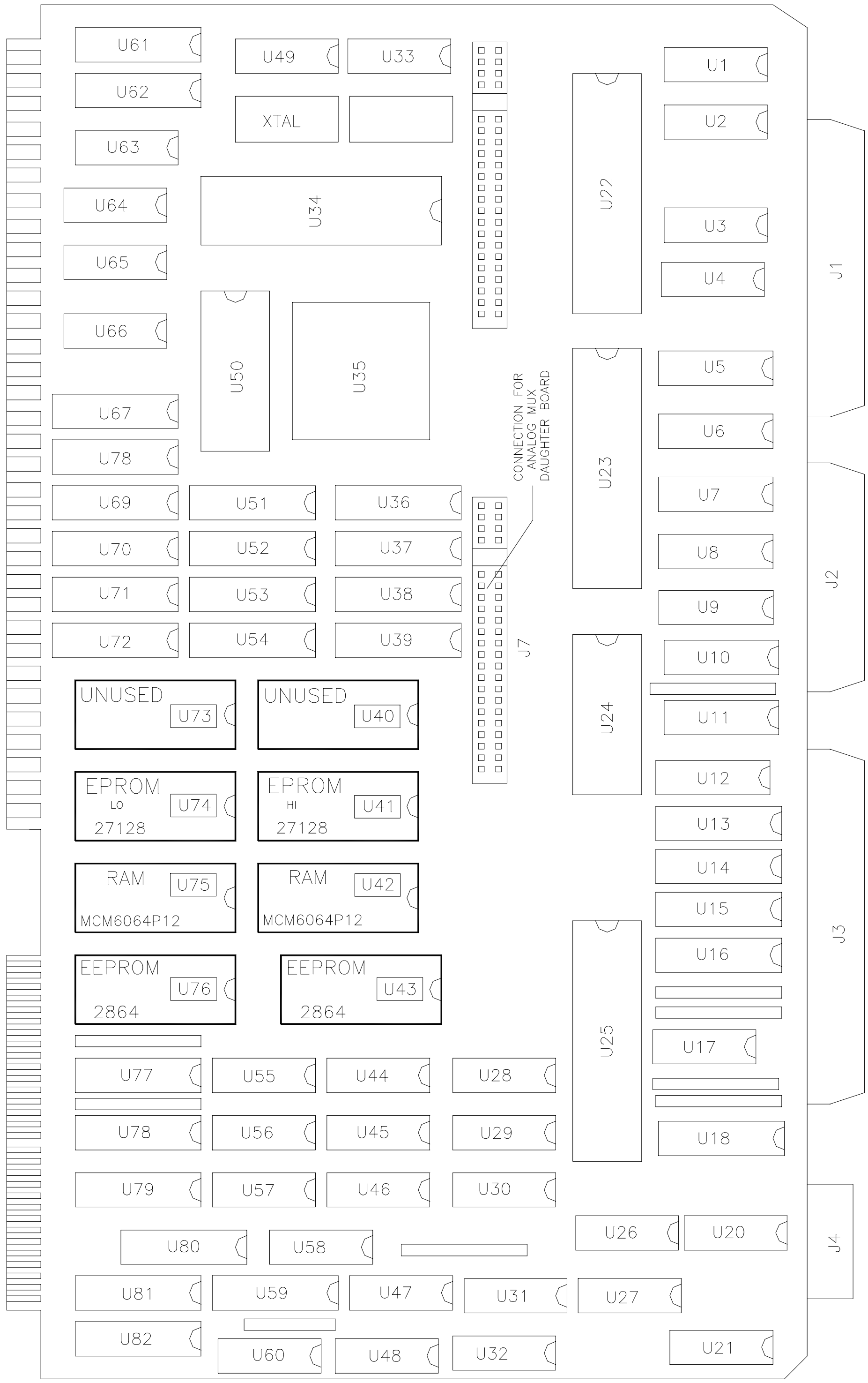


Figure 4-25 Intel Single Board Computer (SBC) Component Layout

4.6.2 Analog Interface Board

The Analog Interface Board performs the following functions;

- Provides signal conditioning (voltage division or inversion) of the system power supply voltages (+60, +28, +15, +5, -5, and -15) so these voltages can be measured by the A/D convertor of the Intel SBC.
- Provides the interface to the sensors which monitor the forward and reflected RF power of the radar antenna.
- Provides the interface to monitor the COHO and LO power levels of the RF Generator.
- Provides the interface to the meters which monitor the internal and external shelter temperatures.

For reference purposes, the Analog Interface Board component layout and schematic diagrams are provided in Figure 4-26 through Figure 4-28.

4.6.3 Digital Interface Board

The Digital Interface Board performs the following functions;

- Provides the driver circuitry to control the 4 solid-state relays for two ECUs, the Exhaust Fan, and the Main Breaker trip function.
- Monitors shelter and antenna access sensors.
- Monitors the Beam Steering Unit (BSU) for switch faults.
- Provides the driver circuitry to individually enable or disable four groups of Power Amplifier Modules in the Transmitter Cabinet.
- Monitors the shelter smoke, flooding, and heat sensors.

For reference purposes, the Digital Interface Board component layout and schematic diagrams are provided in Figure 4-29 through Figure 4-33.

4.6.4 System Status Monitor Replacement Procedure

1. Follow the standard power-down sequence in Section 2.3.

2. Remove the four mounting screws from the front panel of the SSM.

3. Slowly pull the unit to its full-out position.

4. Depress the mounting clips on type "D" connectors P1, P2, and P11, and remove them from ports J1, J2, and J11 at the rear of the SSM (see Figure 4-34).

5. Loosen the retaining nuts on plugs P3, P4, P5, P6, P7, P8, P13, and P14, and disconnect them from ports J3, J4, J5, J6, J7, J8, J13, and J14.

6. Unplug the Inside and Outside Temperature Sensor cables from ports J9 and J10. If the cables are not labeled, note the connections for future reference.

7. Disengage the slide rails and remove the SSM from the Equipment Cabinet with the rails still attached to the unit.

8. Remove the slide rails and attach them to the new System Status Monitor.

9. Install the new unit in the Equipment Cabinet.

10. Plug the Inside and Outside Temperature Sensor cables into ports J9 and J10.

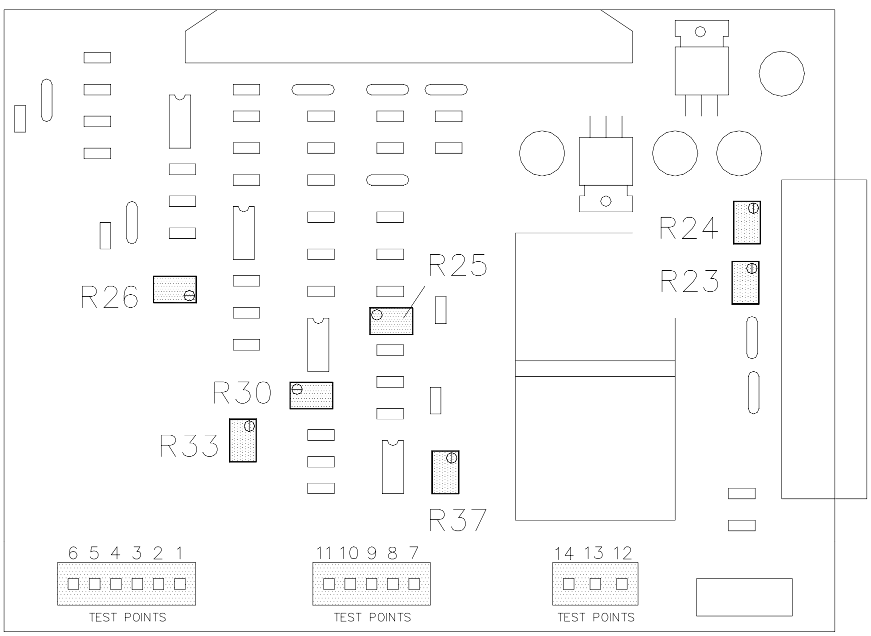
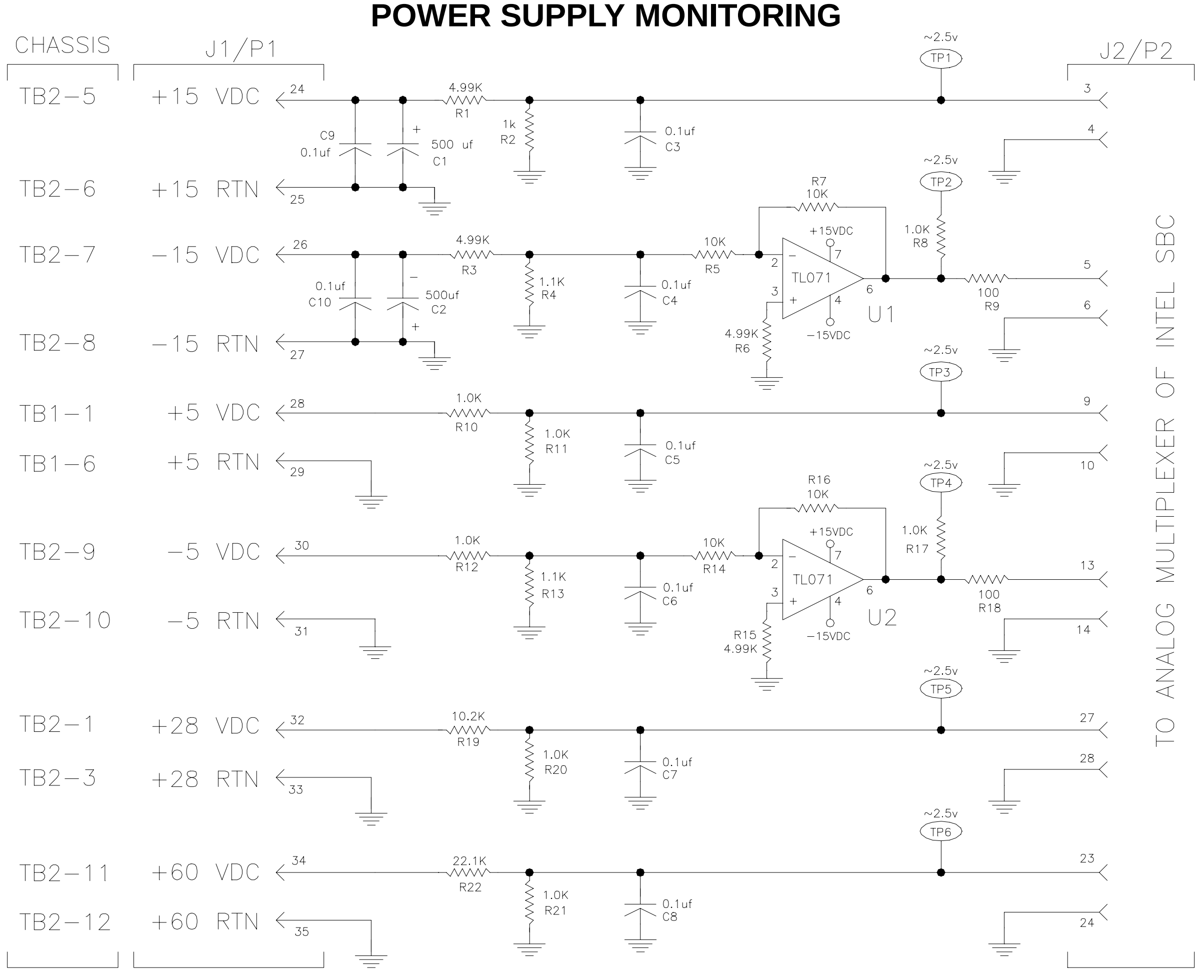
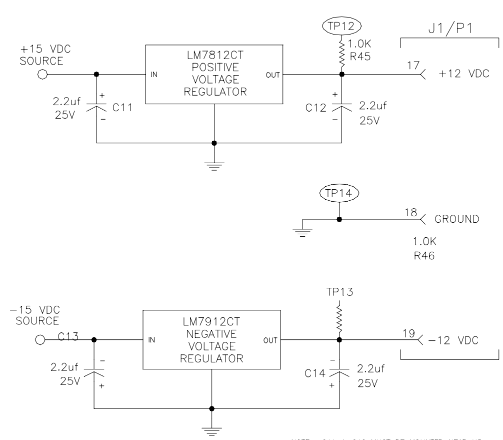


Figure 4-26 Analog Interface Board Component Layout

POWER SUPPLY MONITORING





+/- 12 VDC REGULATORS

Figure 4-27 Analog Interface Board Schematic Diagram (1 of 2)

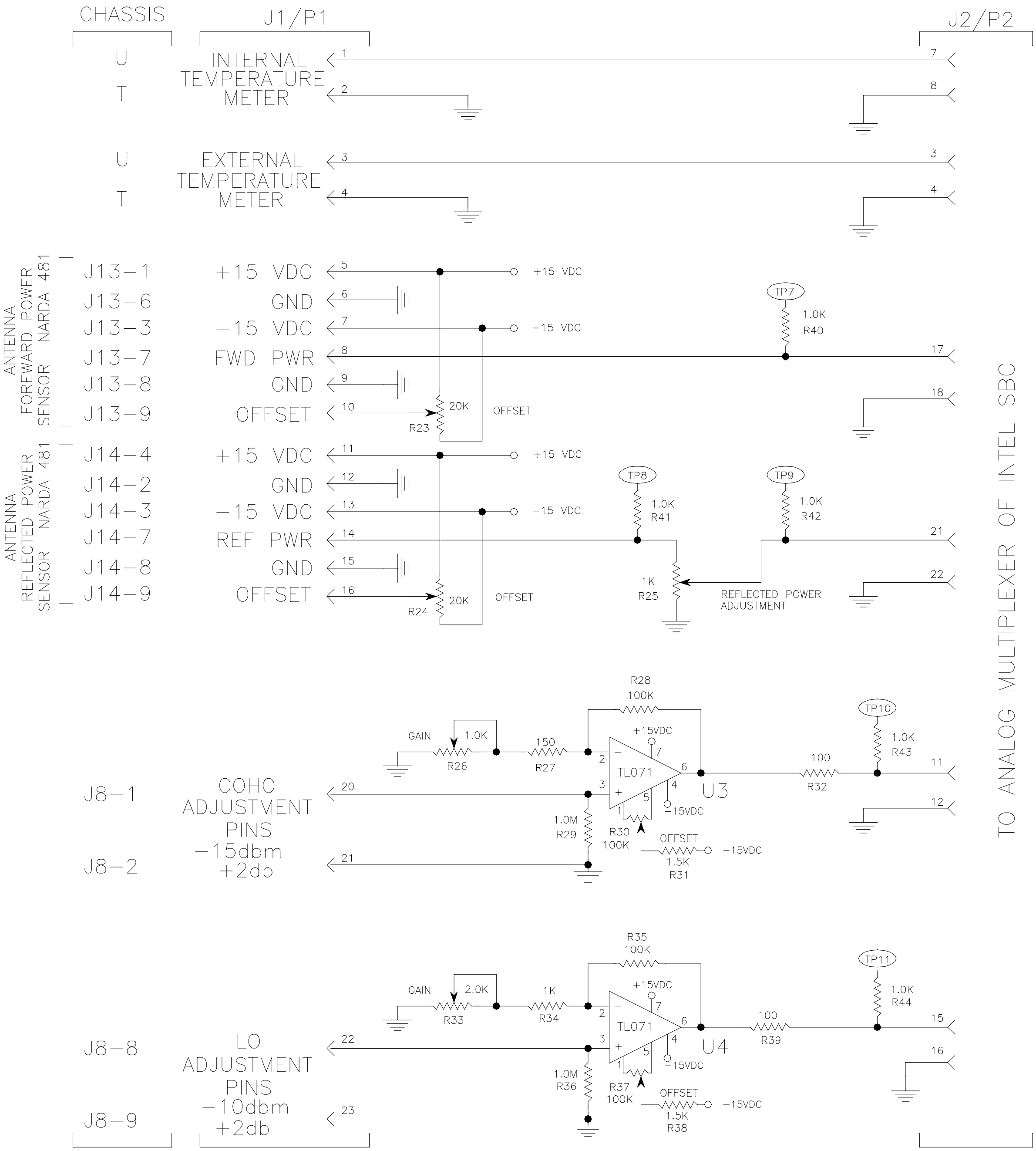


Figure 4-28 Analog Interface Board Schematic Diagram (2 of 2)

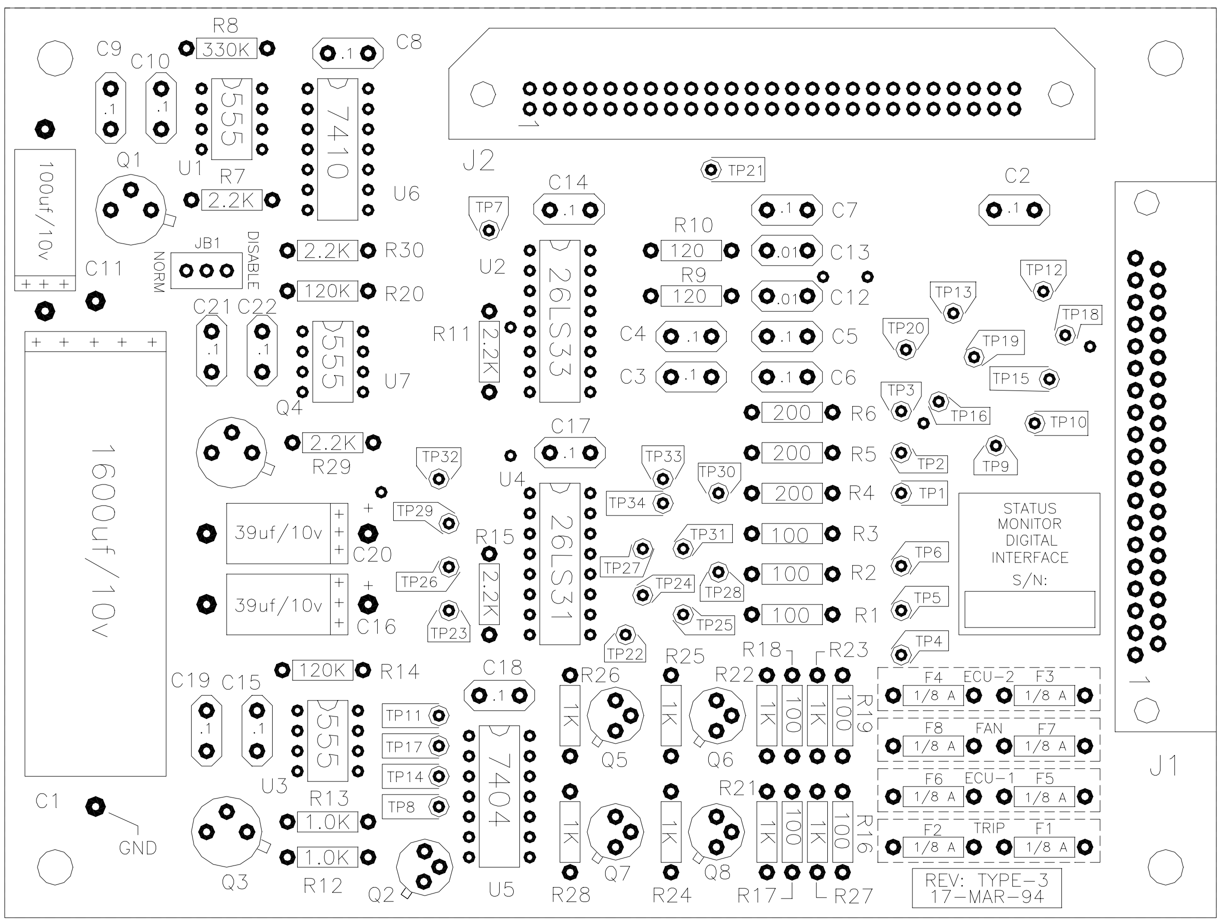


Figure 4-29 Digital Interface Board Component Layout

Access Alarm and Main Breaker Trip Control Circuitry

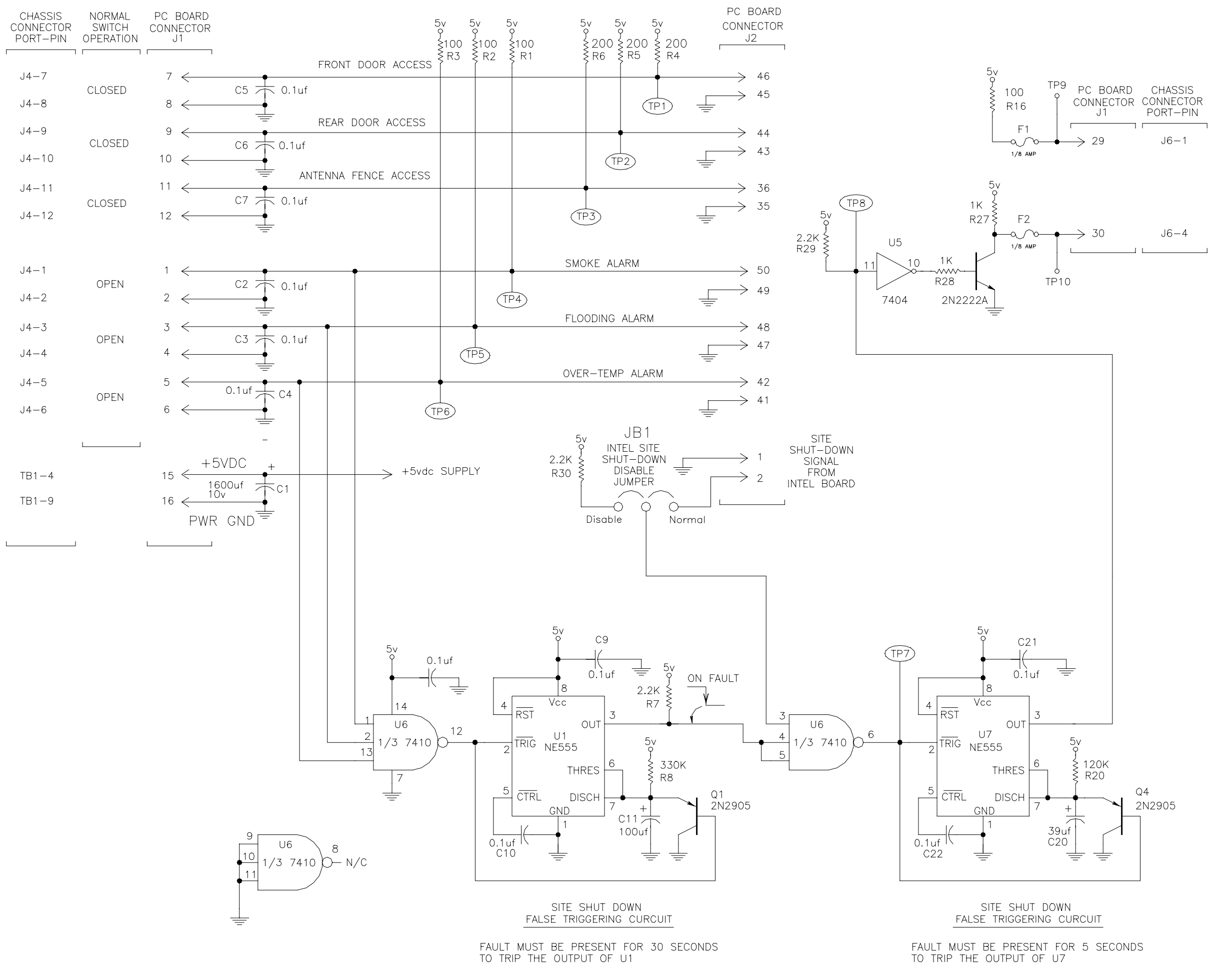


Figure 4-30 Digital Interface Board Schematic Diagram (1 of 4)

PA Module Quad Control Circuitry

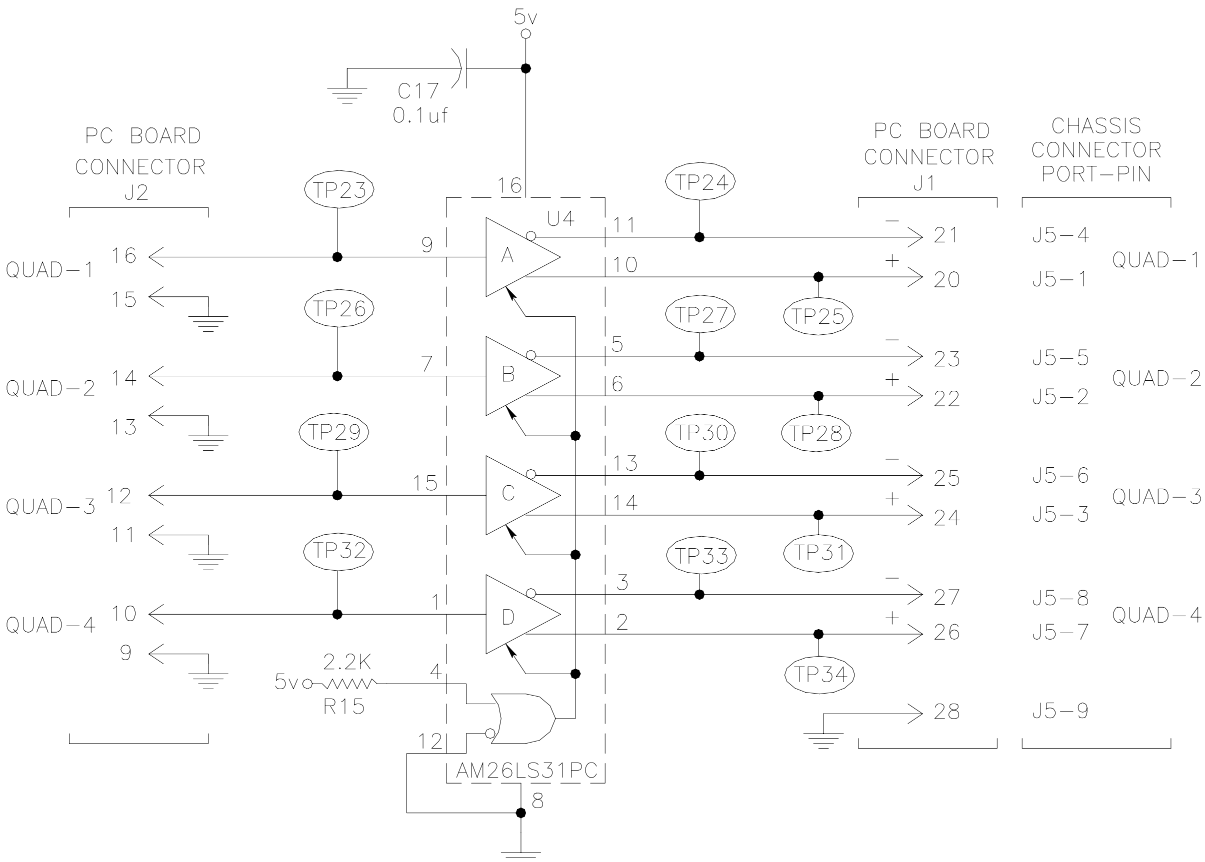


Figure 4-31 Digital Interface Board Schematic Diagram (2 of 4)

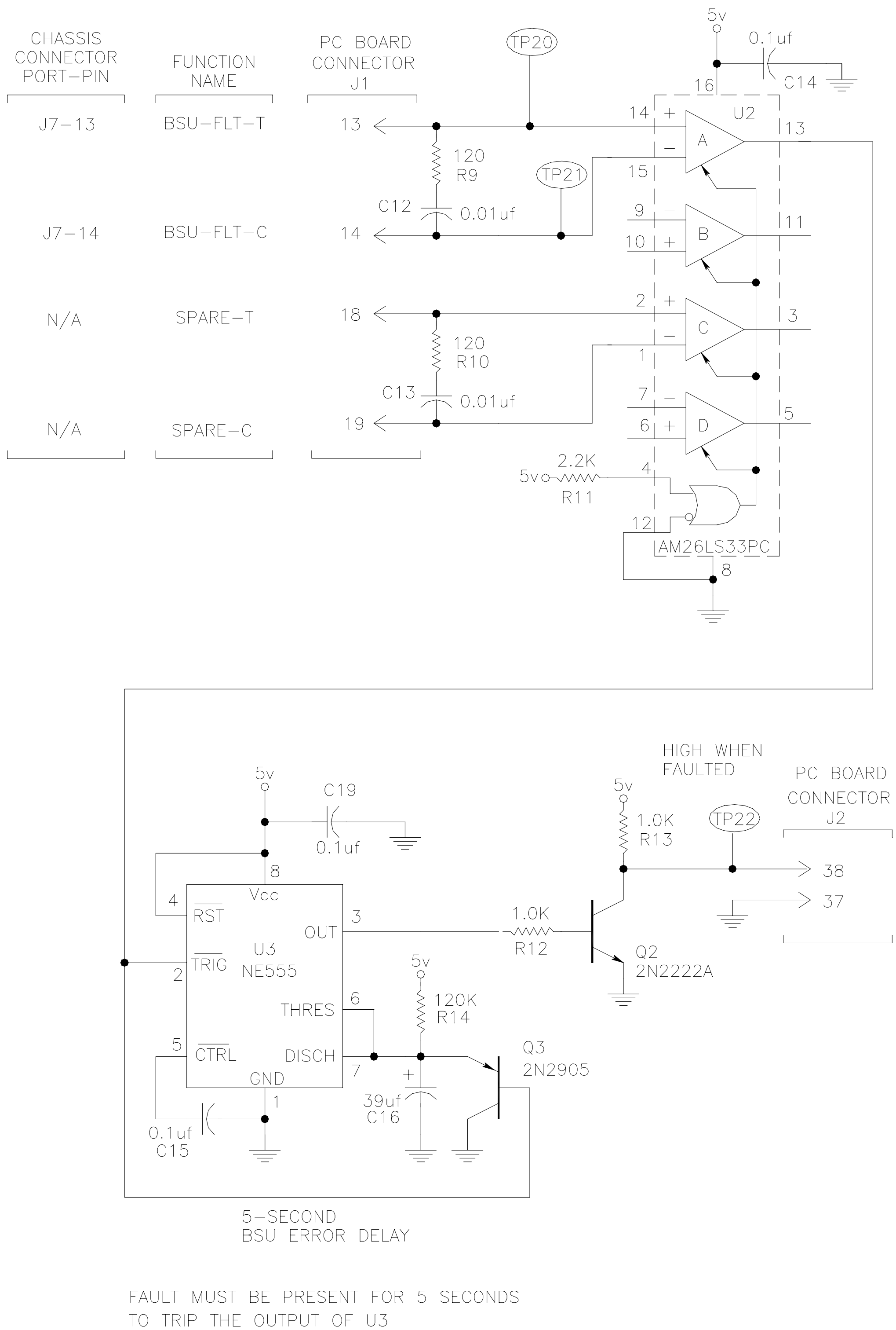


Figure 4-32 Digital Interface Board Schematic Diagram (3 of 4)

Relay Control Circuitry

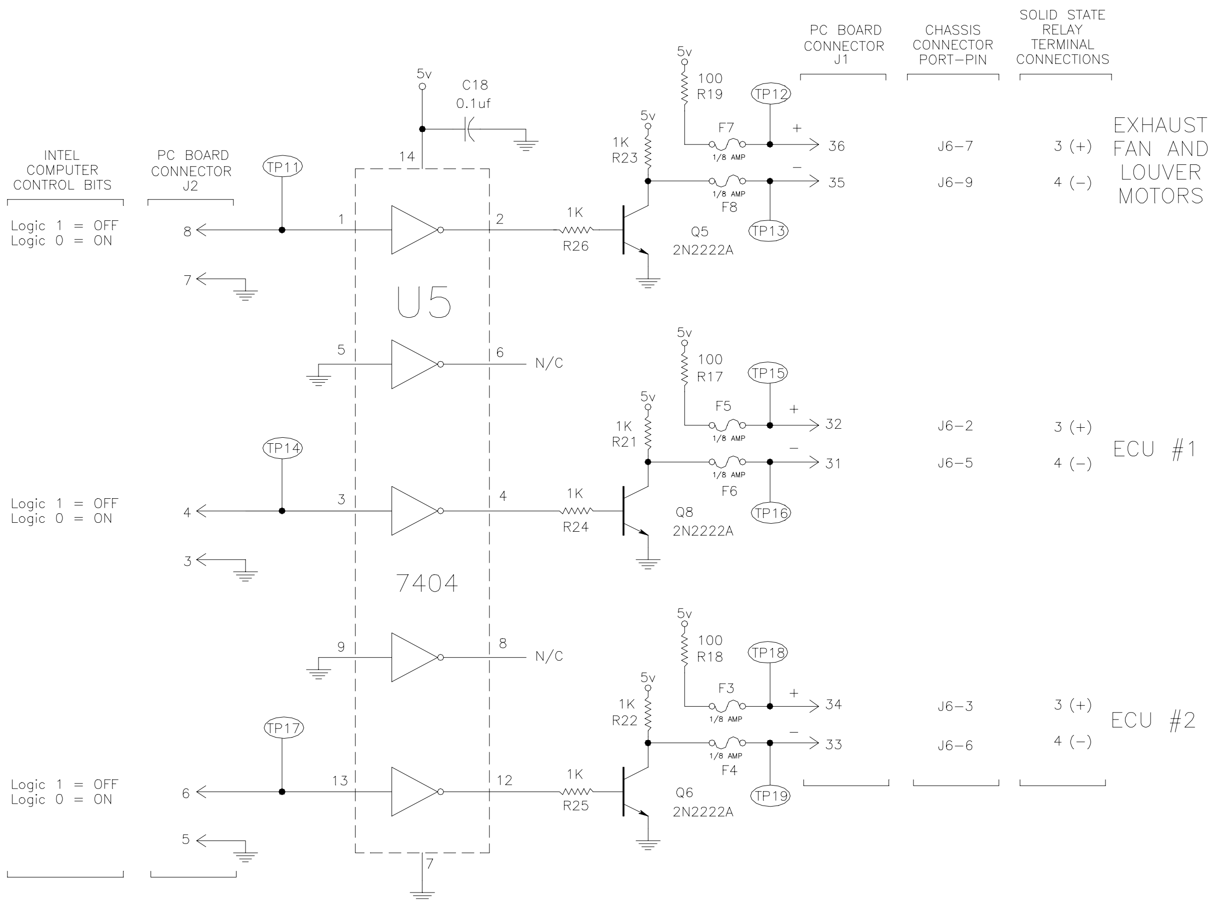


Figure 4-33 Digital Interface Board Schematic Diagram (4 of 4)

J1 = TO PA CABINET (J1), CABLE # W14
J2 = TO DATA PROCESSOR (B1), CABLE # W22
J3 = TO POWER SUPPLY #2 (J2), CABLE # W7
J4 = TO TERM BLOCK #2 (CONTROLS), CABLE # W26
J5 = TO PA CABINET (J1), CABLE # W14
J6 = TO TERM BLOCK #1 (RELAYS), CABLE # W23
J7 = DAISEY CHAIN CABLE FROM BSU (J2) TO SIGNAL PROCESSOR (J8), CABLE # W4
J8 = TO RF GENERATOR DIODE DETECTORS (J9) AND (J11), CABLE # W104
J9 = TO INSIDE TEMP. PROBE, CABLE # W25
J10 = TO OUTSIDE TEMP. PROBE, CABLE # W24
J11 = TO DATA PROCESSOR (C2), CABLE # W21
J13 = TO FORWARD POWER SENSOR (J1), CABLE # W18
J14 = TO REFLECTED POWER SENSOR (J1), CABLE # W19

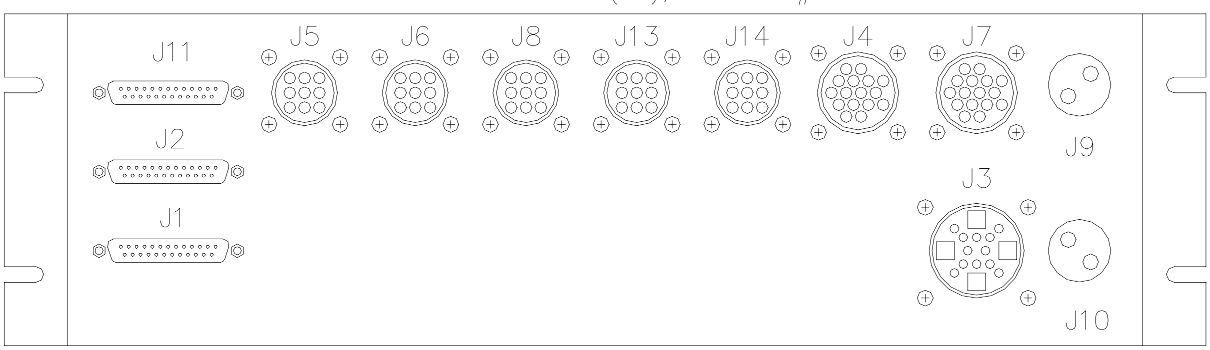


Figure 4-34 System Status Monitor Rear Panel and Cable Connections

11. Connect plugs P3, P4, P5, P6, P7, P8, P13, and P14 into ports J3, J4, J5, J6, J7, J8, J13, and J14, and tighten the retaining nuts.

12. Plug type "D" connectors P1, P2, and P11 into ports J1, J2, and J11, and secure the mounting clips on each connector.

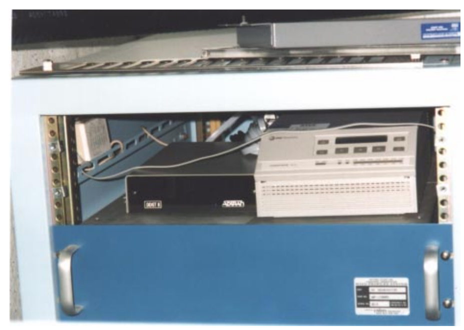
4.6.5 System Status Monitor Calibration Procedure

When the SSM is replaced, it is necessary to re-calibrate the Diode Detectors and perform Zero Offset Adjustments to the Forward and Reflected Power Sensors. A Digital Volt Meter (DVM) is required to perform these procedures.

Coherent and Local Oscillator Trip Level Adjustment

***** WARNING *****

Profiler communications equipment (the DSU) rest on top of the RF Generator behind the air filter panel. Remove the air filter panel above the RF Generator before attempting to pull the RF Generator out from the Equipment Cabinet as shown in photo to right.



1. Remove the four mounting screws from the front panel of the RF Generator and carefully pull the unit to its full-out position.

2. Disconnect the Diode Detectors from ports J9 and J11 on the RF Generator.

3. Remove the top cover panel of the SSM.

***** CAUTION *****

While the Diode Detectors are disconnected from the RF Generator, make sure the metallic housing of the detectors does not come in contact with any other metallic components such as the rack frame or LRU covers. Isolating the detector housing will prevent erroneous meter readings from occurring during the "offset" calibrations.

4. Turn on Circuit Breaker #22 to return power to the Equipment Cabinet.

5. Connect the ground lead of the DVM to TP14(GND) on the SSM Analog Interface Board, and the positive lead to TP10(+). See Figure 4-26 for the location of the test points.

6. Adjust R30 (COHO offset) to produce 0 VDC ± 0.05 VDC.

7. Connect the Diode Detector and cable labeled RFG-P11 to port J11 on the RF Generator.

8. Adjust R26 (COHO gain) to produce 3.75 VDC ± 0.50 VDC.

9. Move the positive lead of the DVM from TP10(+) to TP11(+).

10. Adjust R37 (LO offset) to produce 0 VDC ± 0.05 VDC.

11. Connect the Diode Detector and cable labeled RFG-P9 to port J9 of the RF Generator.

12. Adjust R33 (LO gain) to produce 3.75 VDC +/- 0.50 VDC.

Zero Offset Adjustment

1. Disconnect the Narda 481 Forward Power Sensor from port J6 of the RF Generator, leaving the control cable connected to the sensor.

2. Connect the DVM between TP7(+) and TP14(GND) of the Analog Interface Board inside the SSM chassis (see Figure 4-26).

3. Adjust R23 for 0 VDC (± 10mV).

4. Remove the side panel of the BSU Cabinet (see Figure 2-4).

5. Disconnect the 3-dB pad from the reflected power port of the Directional Coupler (see Figure 5-15).

6. Connect the DVM to TP8(+) and TP14(GND) (see Figure 4-26) and adjust R24 for 0 VDC (± 10mV).

7. Reconnect the 3-dB pad to the reflected power port of the Directional Coupler.

8. Replace the side panel of the BSU Cabinet.

9. Replace the top cover panel of the SSM, push the unit back into the Equipment Cabinet, and replace the four mounting screws on the front panel.

10. Push the RF Generator back into the Equipment Cabinet and replace the four mounting screws on the front panel.

11. Turn off Breaker #22 and follow the standard power-up sequence in Section 2.4.

4.6.6 System Status Monitor EEPROM Replacement Procedure

1. Follow the standard power-down sequence in Section 2.3.

2. Remove the four mounting screws from the front panel of the SSM.

3. Slowly pull the unit to its full-out position.

4. Remove the top cover panel from the SSM.

> ***** CAUTION *****
> The EEPROM chips can be damaged by STATIC ELECTRICITY! Always exercise anti-static precautions and use an anti-static mat and wrist strap when handling these chips.

5. Clip the anti-static wrist-strap to the chassis of the SSM or suitable ground.

6. Place the anti-static mat near the SSM and connect the mat to ground.
7. Remove U43 and U76 from the Intel SBC using the chip-pulling tool (see Figure 4-35 for locations of chips). Place the chips on the anti-static mat.

8. Carefully remove the new EEPROM chips from the anti-static protection and install the chips at locations U43 and U76 on the Intel SBC.

9. Replace the top cover panel of the SSM, push the unit back into the Equipment Cabinet, and replace the four mounting screws on the front panel.

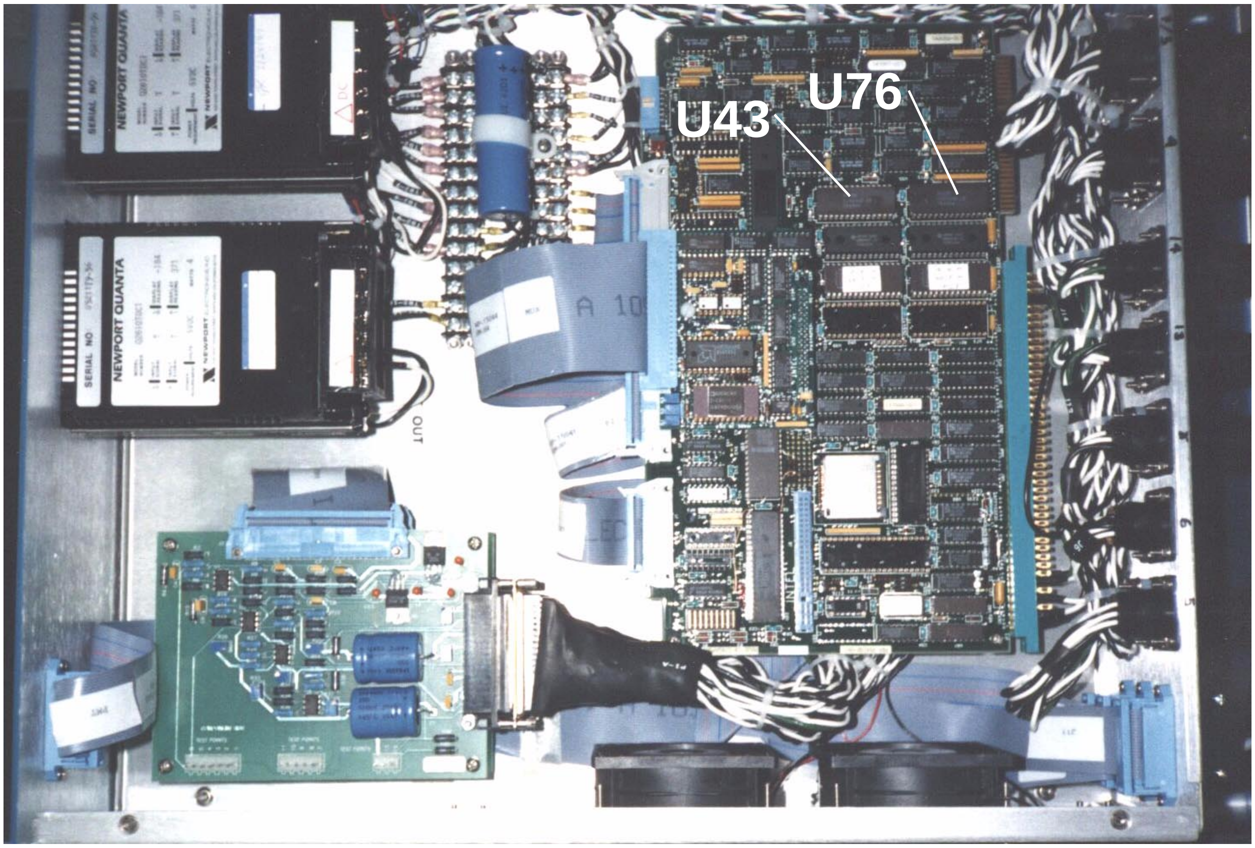


Figure 4-35 Status Monitor EEPROM Chip Replacement

***** NOTE *****
When the EEPROMs are replaced in the SSM, all system parameters, failure data entries, and the SARSAT schedule will be lost. When the radar is powered on it may come up in "Initial System Setup" mode, if it does not, use the PMT to place the radar in "Initial Setup" mode. Contact the PCC for site parameters and SARSAT schedule if required.

10. Follow the standard power-up sequence described in Section 2.4.

11. Connect the PMT and log in to the system.

12. Using the PMT, enter the parameters required by the Initial System Setup menus.

13. If a current SARSAT turn-off schedule diskette has been acquired prior to this procedure, load the schedule at this time. The radar must be in Operational mode to load the SARSAT schedule from diskette. If a current SARSAT schedule diskette is not available, contact the PCC and a schedule will be down-loaded to the profiler over the landline communications link.

4.7 Power Supplies

Power Supplies #1 and #2 are the bottom two units of the Equipment Cabinet (see Figure 4-1). Power Supply #1 (PS #1) consists of two short-circuit protected subsidiary power supplies: +5.25 VDC and +28 VDC. Power Supply #2 (PS #2) consists of the following short-circuit protected subsidiary power supplies: two (2) +60 VDCs; one +15 VDC; one -15 VDC; and one -5 VDC. Figure 4-36 shows the interfaces between various profiler components and the two power supplies. The front and rear panels of PS #1 and PS #2 are illustrated in Figure 4-37 and Figure 4-38, respectively.

The two +60 VDC subsidiary power supplies in PS #2 provide primary and backup power to the system T/R Switch. After installation, these power supplies are adjusted to +61 VDC for the primary supply and +59 VDC for the backup supply. The output of each +60 VDC power supply is connected in parallel through diodes to provide electrical isolation between the two power supplies (see Figure 4-36).

The failure of any subsidiary power supply triggers a fault in the System Status Monitor that is written to the SSM Failure Data log.

4.7.1 Power Supply Fault Isolation

Any of the components identified in Figure 4-36 may draw too much current, causing the short-circuit protection in one or more of the subsidiary power supplies to activate. For this reason, it is necessary to determine if the problem is in the power supplies or in one of the other system components.

A Digital Volt Meter (DVM) is required for the following procedures:

1. Follow the standard power-down sequence described in Section 2.3.

2. Inspect the fuses in both power supplies and replace, if necessary.

3. Disconnect all components that draw current from the power supplies. The most convenient place to do this is on the rear panel of PS #2 (see Figure 4-38).

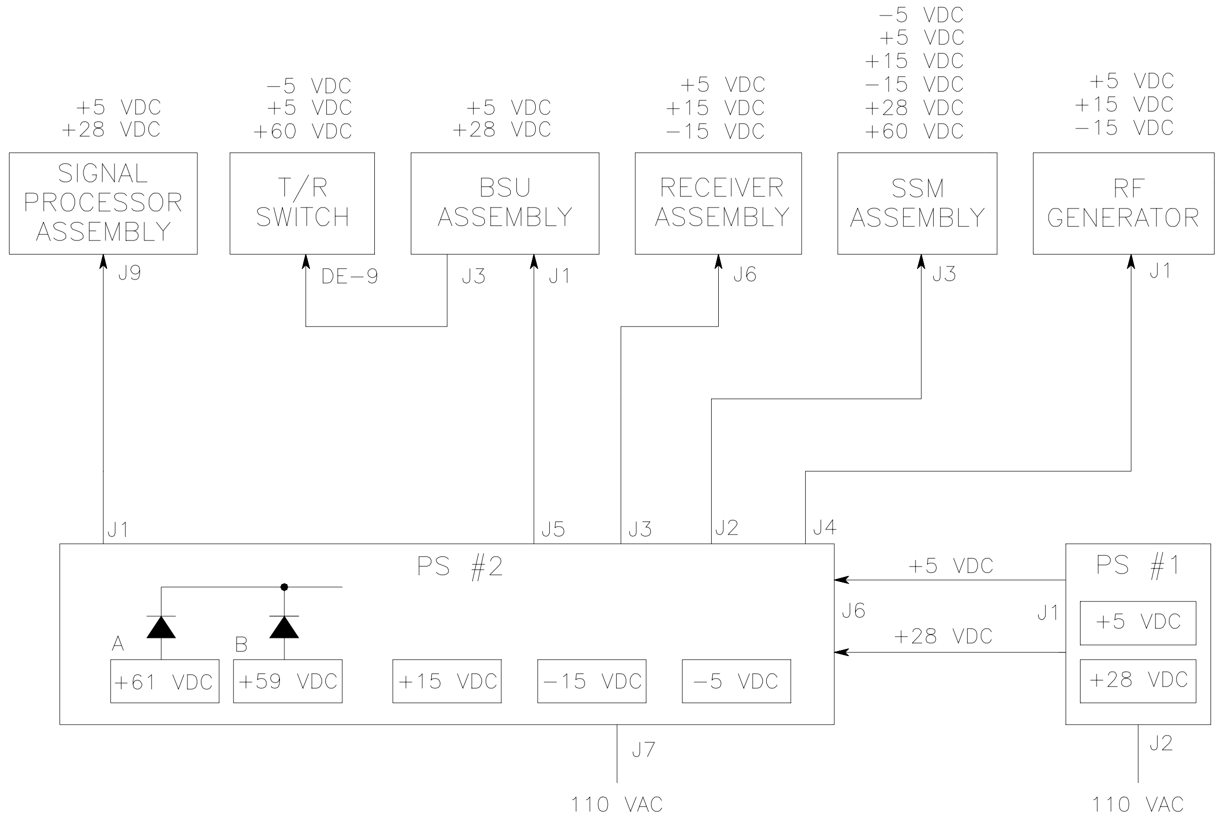


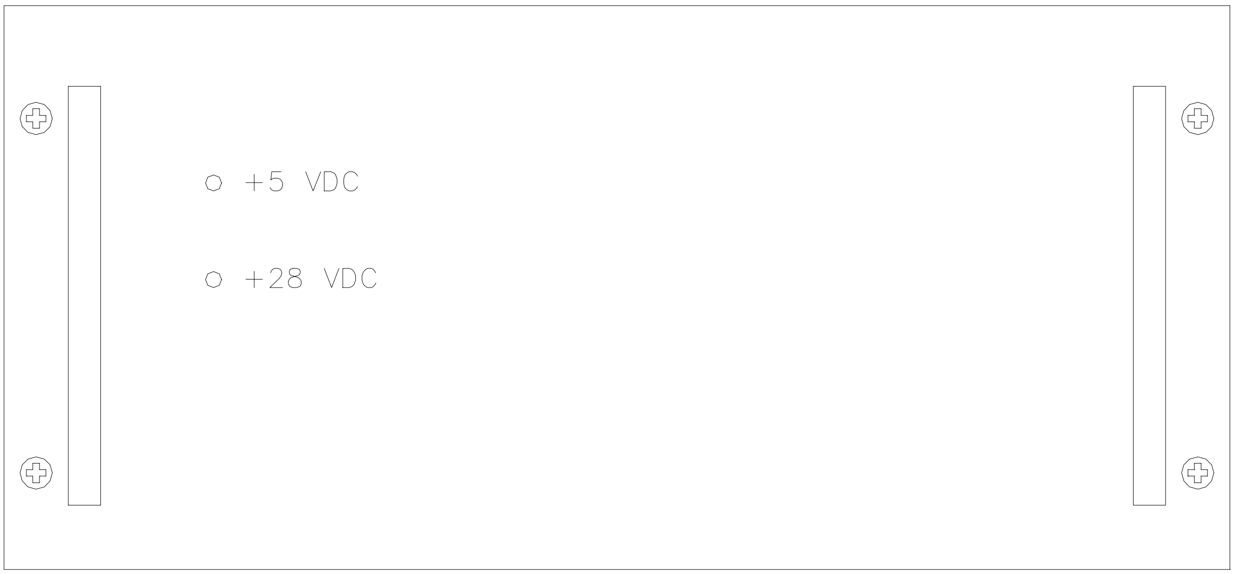
Figure 4-36 Equipment and BSU Cabinet DC Power Distribution

4. Turn on Breaker #22 to return power to the Equipment Cabinet. Measure the voltages at the output terminals of the power supplies and verify that the correct voltage levels are present. Refer to Figure 4-39 and Figure 4-40 for the location of the subsidiary power supplies in PS #1 and PS #2.

   If the voltages are out of specification, the problem has been isolated to a subsidiary power supply in PS #1 or PS #2. Disconnect cable P6 from port J6 on the rear panel of PS #2 (see Figure 4-38) to isolate the power supplies. Again measure the voltage levels to isolate the problem to one of the power supplies. See Section 4.7.2 and Section 4.7.3 for the power supply replacement procedures.

   If the measured voltages are within specification, the problem exists in one or more of the other radar components. Turn off Equipment Cabinet (Breaker #22) and re-connect cable P6 to port J6 on the rear panel of PS #2.

Power Supply #1 Front Panel



Power Supply #2 Front Panel

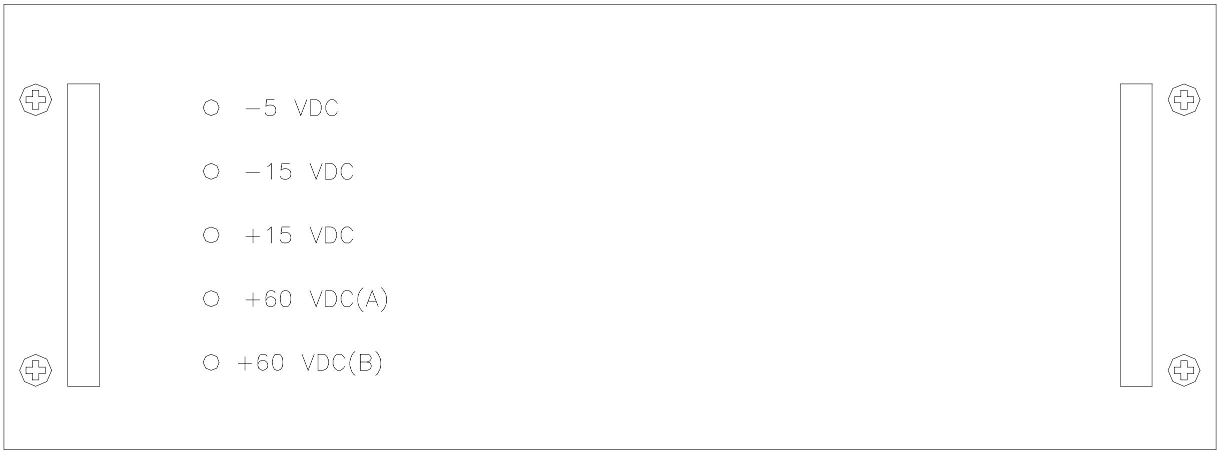
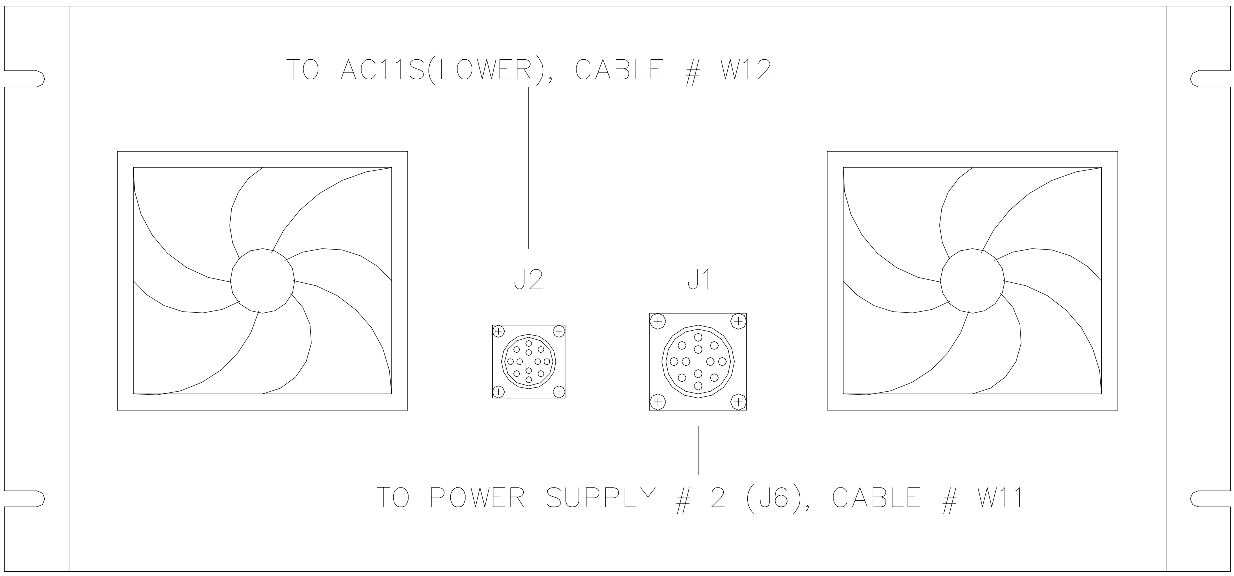


Figure 4-37 Power Supply #1 and #2 Front Panels

Power Supply #1 Rear Panel



Power Supply #2 Rear Panel

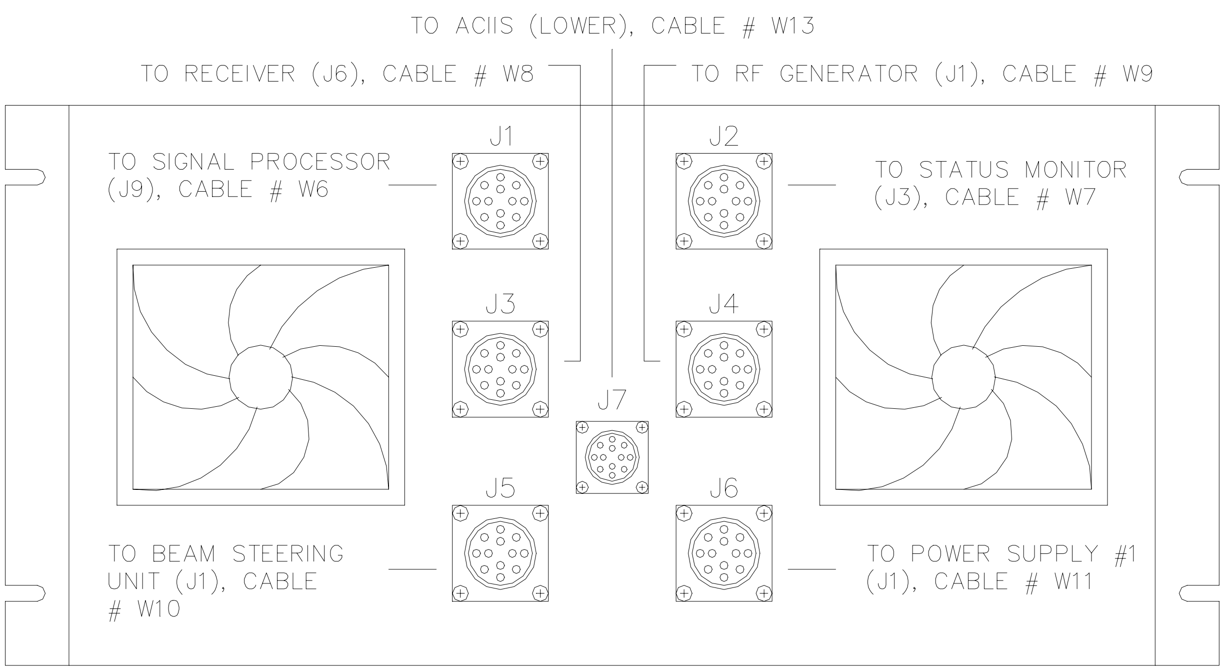
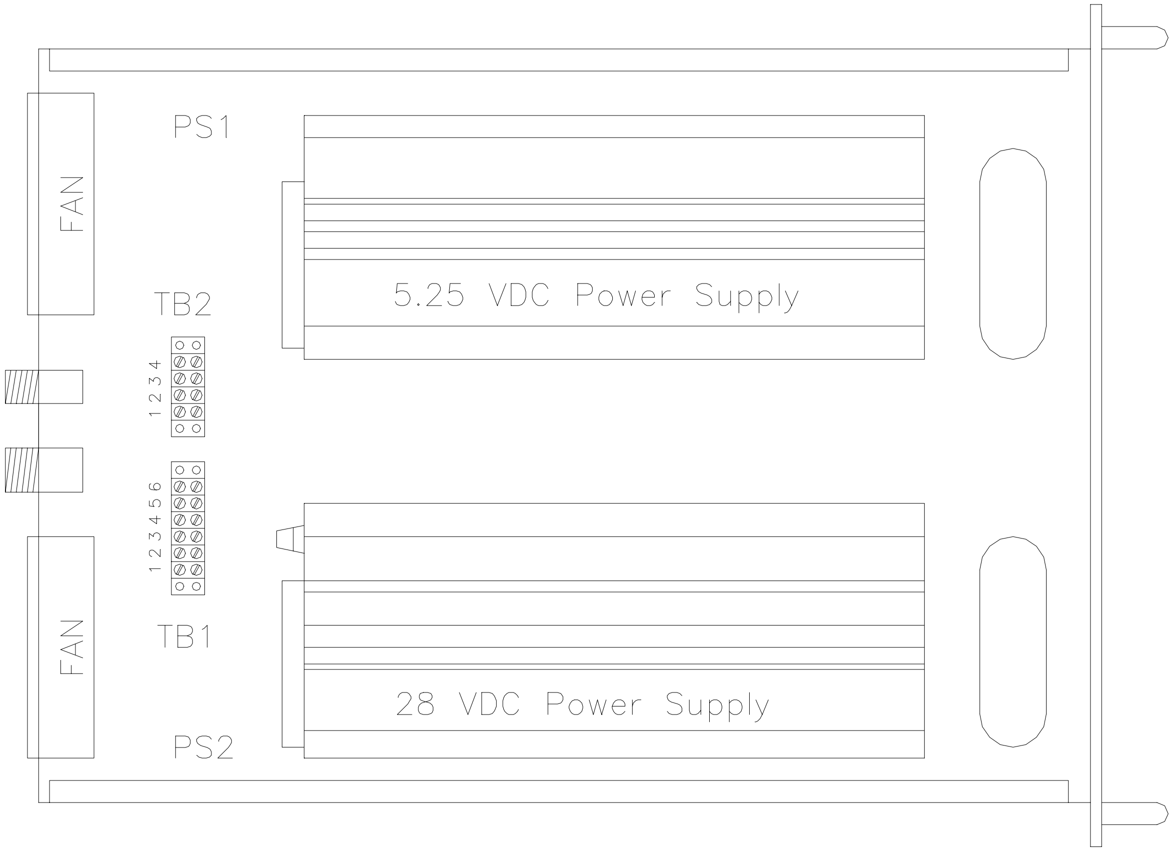


Figure 4-38 Power Supply #1 and #2 Rear Panels



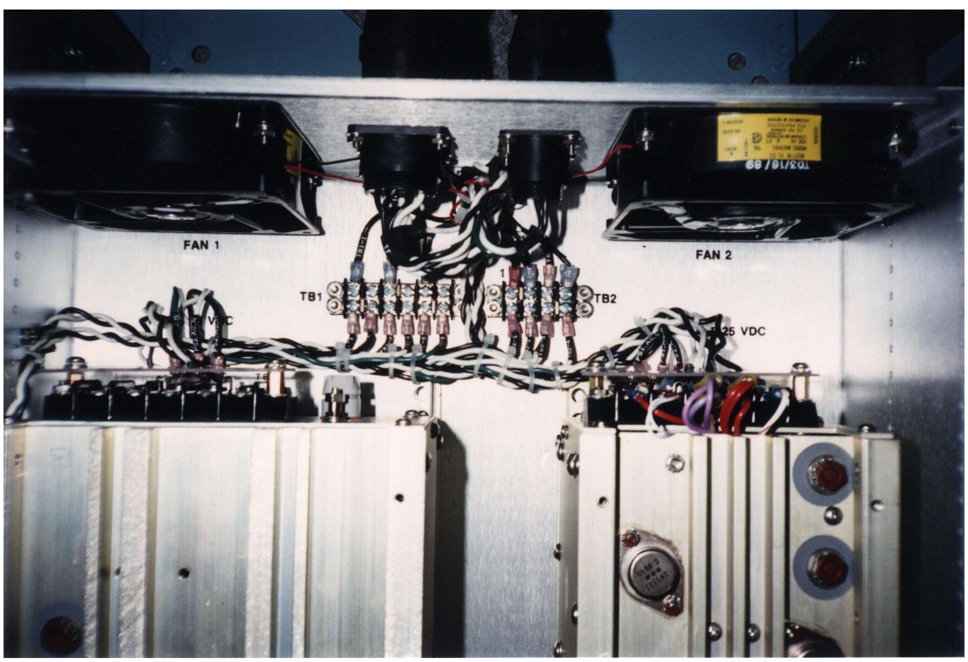
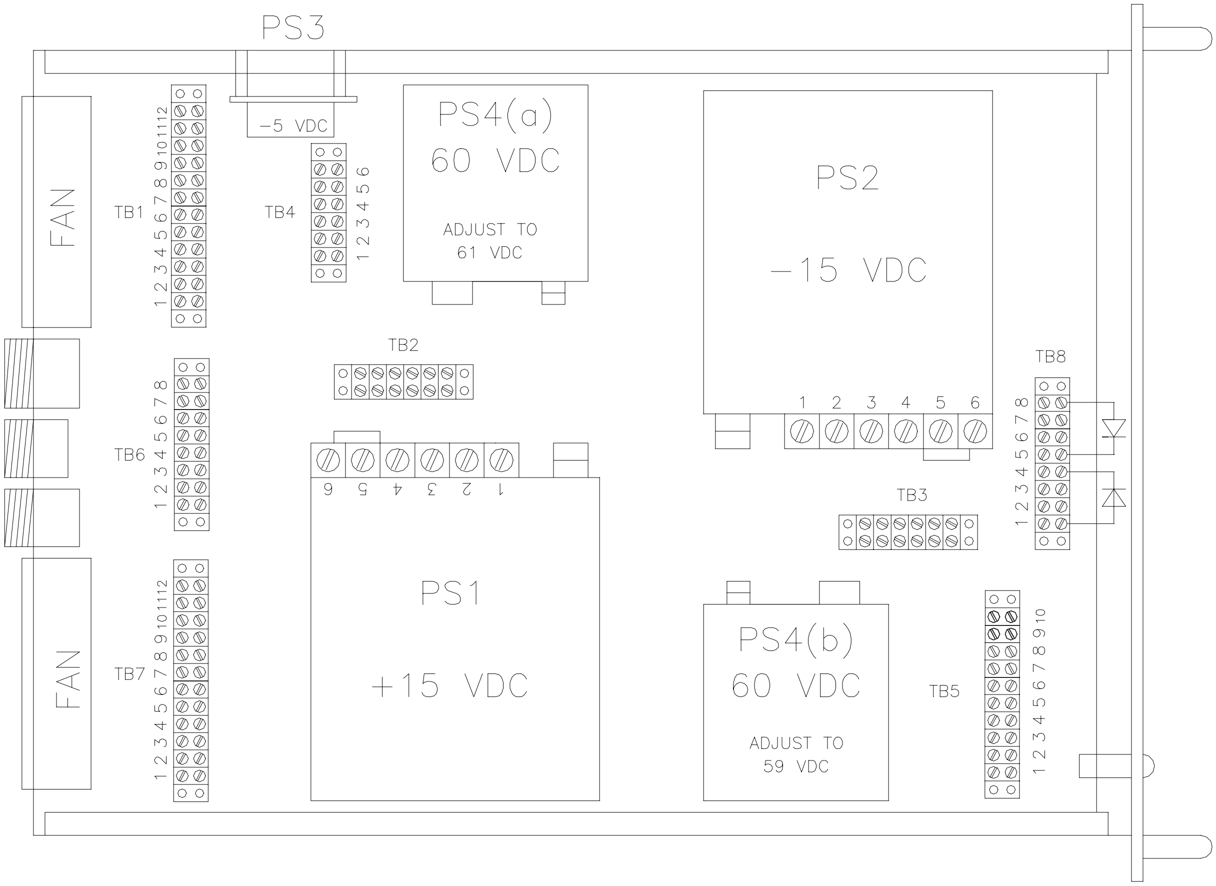


Figure 4-39 Power Supply #1 Internal Component Layout



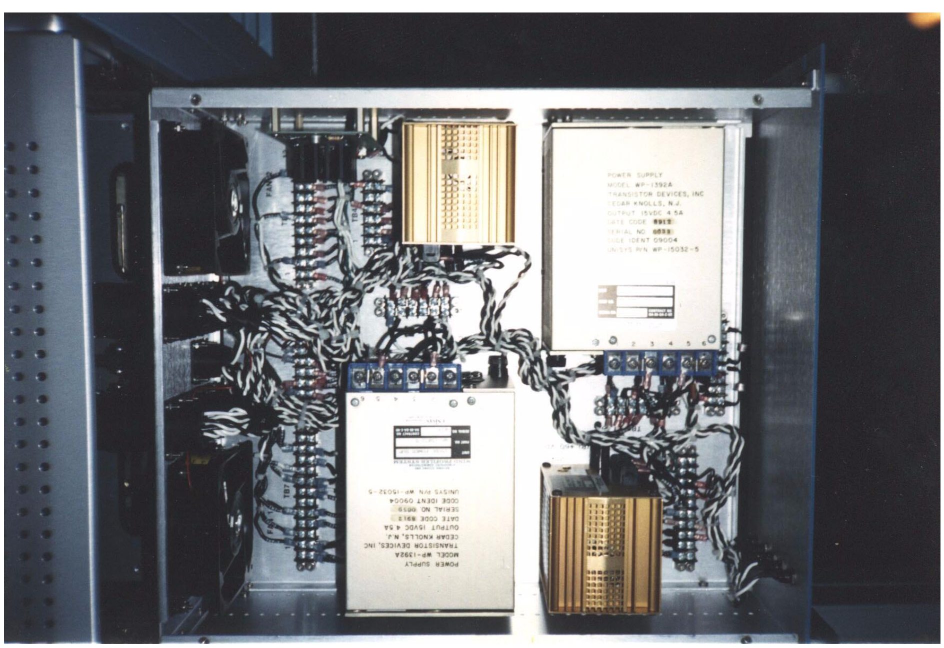


Figure 4-40 Power Supply #2 Internal Component Layout

5. Connect one of the radar components to PS #2 and return power to the Equipment Cabinet by turning on Breaker #22. Observe the indicator lights on the front panels of PS #1 and #2, and measure the voltage levels as described above. Turn off Breaker #22 and repeat this procedure until the faulty component is identified.

4.7.2 Power Supply #1 Replacement Procedures

4.7.2.1 Replacement of Subsidiary Power Supplies

1. Follow the standard power-down sequence described in Section 2.3.
2. Remove the four mounting screws from the front panel of PS #1.
3. Carefully pull the PS #1 chassis from the Equipment Cabinet to its full-out position and remove the top cover of the unit.
4. Locate the subsidiary power supply to be replaced (see Figure 4-39) and remove its mounting screws from the underside of the chassis.
5. Disconnect the AC and DC leads from the appropriate terminal block and remove the faulted power supply from the chassis.
6. Install the new subsidiary power supply in the chassis and connect the appropriate AC and DC leads.
7. Replace the mounting screws from the underside of the chassis.
8. Replace the top cover of the chassis and reconnect all power connectors on the rear panel.
9. Push PS #1 into the Equipment Cabinet and replace the mounting screws on the front panel.
10. Follow the standard power-up sequence described in Section 2.4.

4.7.2.2 Replacement of the Entire Power Supply #1 Unit

1. Follow the standard power-down sequence described in Section 2.3.
2. Remove the four mounting screws from the front panel of PS #1.

3. Slowly pull the PS #1 chassis from the Equipment Cabinet to its full-out position.

4. Loosen the retaining nut on plugs P1 and P2 and remove them from connectors J1 and J2 on the rear panel of the unit.

5. Disengage the slide rails and remove PS #1 from the Equipment Cabinet with the rails still attached to the unit.

6. Remove the slide rails from the old unit and attach them to the new PS #1.

7. Install the new PS #1 in the Equipment Cabinet.

8. Connect Plugs P1 and P2 to ports J1 and J2 and tighten the retaining nuts on the plugs.

9. Push the unit back into the cabinet and replace the mounting screws on the front panel.

10. Follow the standard power-up sequence described in Section 2.4.

4.7.3 Power Supply #2 Replacement Procedures

4.7.3.1 Replacement of Subsidiary Power Supplies

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the four mounting screws from the front panel of PS #2.

3. Slowly pull the PS #2 chassis from the Equipment Cabinet to its full-out position and remove the top cover of the unit.

4. Locate the subsidiary power supply to be replaced (see Figure 4-40) and remove its mounting screws from the underside of the chassis.

5. Disconnect the AC and DC leads from the appropriate terminal block and remove the faulty power supply from the chassis.

6. Install the new subsidiary power supply in the chassis and connect the appropriate AC and DC leads.

7. Replace the mounting screws from the underside of the chassis. If replacing a +60 VDC subsidiary supply, perform the following adjustments:

Turn on Breaker #22 to return power to the Equipment Cabinet. Use a DVM to measure the voltage output of the subsidiary supplies directly at their output terminals. Power supply 4A should be adjusted to +61 VDC and power supply 4B should be adjusted to +59 VDC.

8. Replace the top cover of the chassis and reconnect all power connectors on the rear panel.

9. Push PS #2 into the Equipment Cabinet and replace the mounting screws on the front panel.

10. Follow the standard power-up sequence described in Section 2.4.

4.7.3.2 Replacement of the Entire Power Supply #2 Unit

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the four mounting screws from the front panel of PS #2.

3. Slowly pull the PS #2 chassis from the Equipment Cabinet to its full-out position.

4. Loosen the retaining nuts on plugs P1-P7 and remove the plugs from connectors J1-J7 on the rear panel of the unit.

5. Disengage the slide rails and remove PS #2 from the Equipment Cabinet with the rails still attached to the unit.

6. Remove the slide rails from the old unit and attach them to the new PS #2.

7. Install the new PS #2 in the Equipment Cabinet.

8. Connect plugs P1-P7 to ports J1-J7 and tighten the retaining nuts on the plugs.

9. Push the unit back into the cabinet and replace the mounting screws on the front panel.

10. Follow the standard power-up sequence described in Section 2.4.

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5 Beam Steering Unit Cabinet

The Beam Steering Unit (BSU) Cabinet is located near the antenna field access door as illustrated in Figure 2-4 and Figure 2-6. The front view of the BSU Cabinet is shown in Figure 5-1, and the internal component layout of the cabinet in Figure 5-2.

The BSU Cabinet contains the following items: the Beam Steering Unit (BSU) Assembly; the Five-Way Power Divider; the Directional Coupler; the RF Limiter (usually referred to as the Limiter); the Transmit/Receive (T/R) Switch; the Coaxial Circulator (usually referred to as the Circulator); the Receiver Assembly; and the Reflected Power Sensor.

5.1 Type 2 449 MHz Receiver Assembly

The Type 2 Receiver Assembly is located above the BSU Assembly in the Beam Steering Unit Cabinet (see Figure 5-2). The Type 2 Receiver Assembly is a complete redesign of the original Type 1 404 MHz Receiver and is further modified to operate at 449 MHz. Design enhancements include; more rugged mechanical structure, better noise stability, and a modular input amplifier. The Type 2 Receiver is a superheterodyne design that performs an analog-to-digital (A/D) conversion of the returned Doppler-shifted signal before sending it to the Signal Processor Assembly.

5.1.1 Type 2 Receiver Replacement Procedure

Estimated time to complete procedures: 2-5 hours on site.

Required Tools and Test Equipment

• 5/16" Open End Wrench	for SMA connector removal & installation
• #2 Phillips Head Screwdriver	for chassis removal, installation, and STC alignment
• #2 Flat Head Screwdriver	for connector removal and installation
• Small Flat Head Screwdriver	for connector removal and installation
• 60-100MHz Oscilloscope	for STC alignment
• Alignment Tool (tweeker)	provided with the Type II Receiver for STC alignment and IF gain adjustment
• SMA (M) to BNC (F) Adaptor	for STC alignment
• 6' RG-58 Cable, BNC(m)-(m)	for STC alignment
• 50 Load	for Receiver Noise/Gain measurement and adjustment

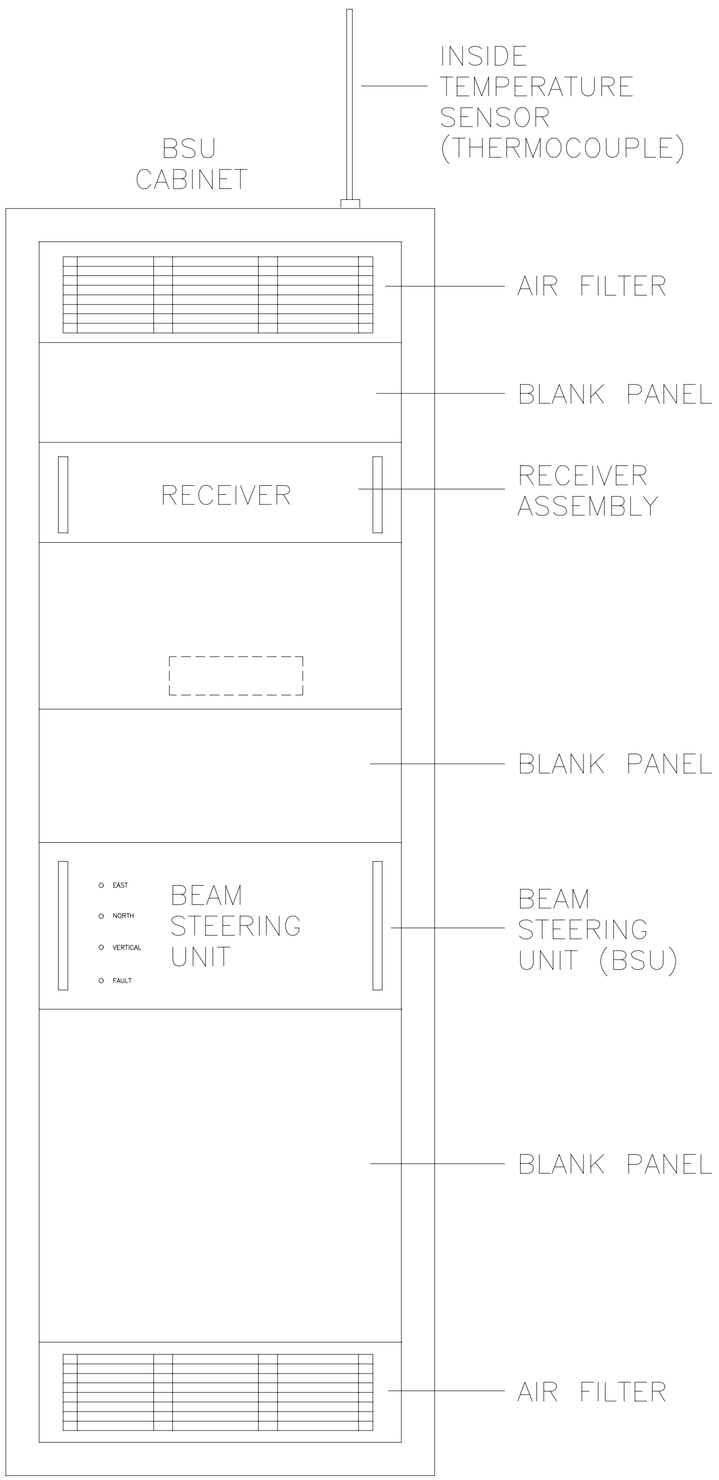


Figure 5-1 Beam Steering Unit (BSU) Cabinet Front Panel

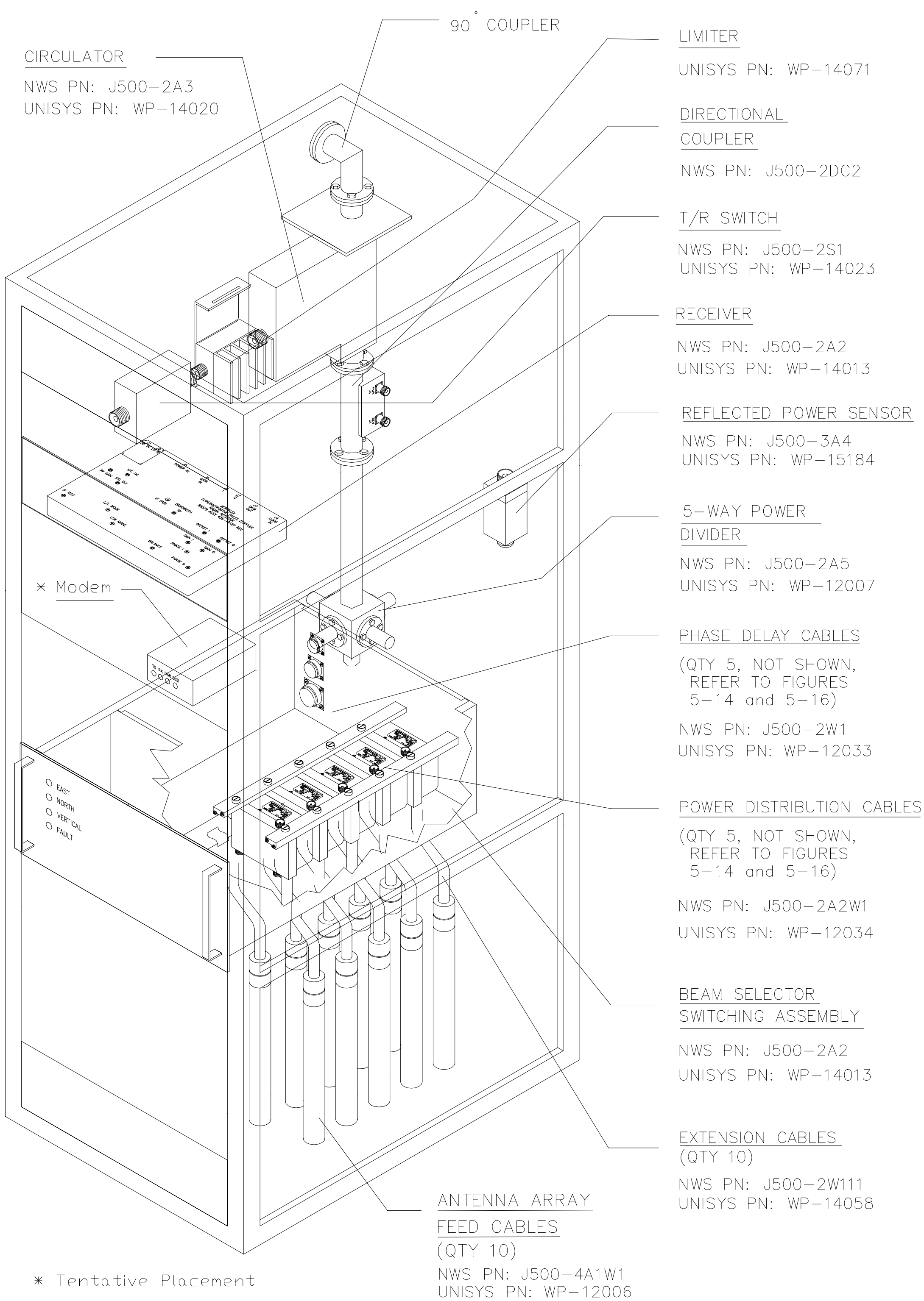


Figure 5-2 Beam Steering Unit (BSU) Cabinet Internal Component Layout

Receiver Removal Procedure

1. Power down the profiler using the standard power-down sequence described in Section 2.3.

2. Remove the side panel from the BSU Cabinet.

3. Disconnect the coaxial cables from ports J2 (LO) and J4 (COHO) on the rear panel of the Receiver (see Figure 5-3).

4. Disconnect the cables from ports J5 (control) and J3 (output) on the rear panel of the Receiver.

5. Disconnect the coaxial cable from port J1 (RF Input) on the rear panel of the Receiver.

6. Disconnect the power cable from the port J8 on the rear panel of the Receiver.

7. Remove the four mounting screws from the front panel of the Receiver and slide the unit out the front of the BSU Cabinet.

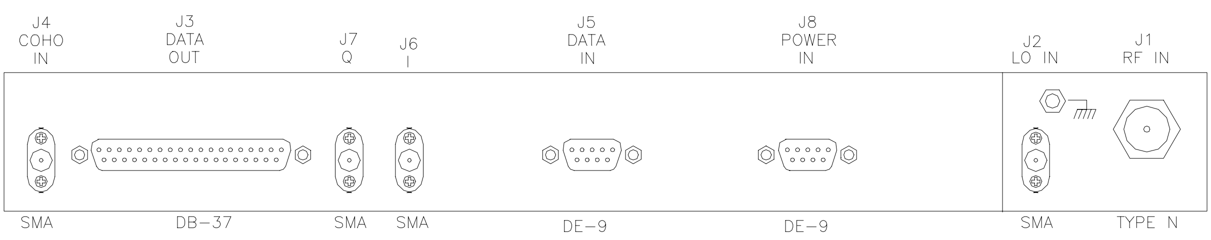


Figure 5-3 Type 2 Receiver Rear Panel

Type 2 Receiver Installation Procedure

1. Install the Type 2 Receiver in the BSU Cabinet and secure the four mounting screws on the front panel.

2. Attach the adaptor cable WP-14064 (supplied with the Type 2 Receiver) to the existing power cable, and connect the adaptor cable to port J8 on the rear panel of the Type 2 Receiver.

3. Reconnect the interface cables to ports J2, J3, J4, and J5 on the rear panel of the Type 2 Receiver (see Figure 5-3).

4. Connect the braided ground strap (supplied with the Type 2 Receiver) to the ground lug (located above J2) on the rear panel of the Type 2 Receiver. Attach the other end of the braided ground strap to the BSU Cabinet frame using an existing bolt or screw.

5.1.2 Type 2 Receiver Noise Measurement

A proven method of calibrating the Receiver gain is to use the Profiler's signal processing to measure the Receiver noise level. During this calibration, a 50 load is used to terminate the input of the Receiver (J1) to isolate it from any external noise sources. During the measurement, the profiler should be cycling normally in Operational Mode. The Profiler Maintenance Terminal (PMT) is used to display the value of the system noise.

1. Attach a 50 ohm terminator load to RF IN(put) port (J1) on the rear panel of the Type 2 Receiver.

2. Power up the Profiler using the sequence described in Section 2.4 and wait for the system to begin cycling normally.

3. Connect the PMT Interface Cable to the front panel of the Status Monitor, and power-up the PMT (laptop computer).

4. Once the PMT has logged onto the profiler, place the profiler into *Maintenance Mode*. The Profiler's *Diagnostic Spectrum* parameters need to be set to a specific beam and range gate. Contact the PCC at (303) 497-6033 and technicians will provide assistance setting the diagnostic spectrum parameters.

5. After the Diagnostic Spectrum and been set and the radar is returned to *Operational Mode*, let the radar go through one or two complete beam cycles.

*** NOTE ***

One complete beam cycle is defined as follows:

East High ->East Low ->North High ->North Low ->Vertical Hi ->Vertical Low

The indicator LEDs on the front panel of the BSU Switch Assembly can be used to determine what beam the profiler is currently in.

6. Select Display Current Output from the PMT Main Menu. Select Landline from the menu. Select Status Data from the menu. The *System Status Data Block* screen will appear on the PMT (see Figure 5-4).

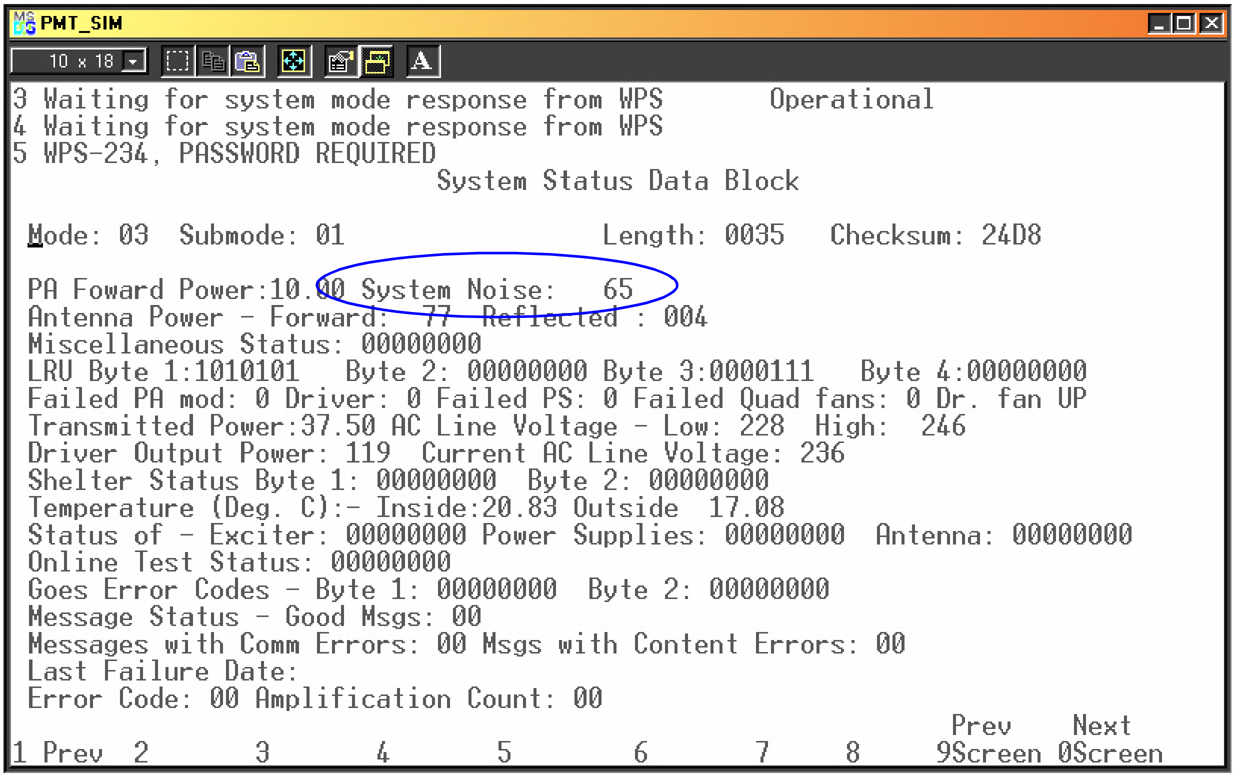


Figure 5-4 Profiler Maintenance Terminal Status Data Block Screen

7. Locate the *System Noise* field on the PMT screen, this number should be 63 ±1 with the Receiver Input (J1) terminated with a 50 ohm load. To assure repeatability of the System Noise value, let the radar cycle through the beams several times. Each time the East beam is reached, back out of the Status Data Menu by pressing F1 on the PMT. Select Status Data again and check the System Noise.

   If the system noise is approximately 063 ±1, no adjustment is required, proceed with the STC Alignment procedure described in Section 5.1.4. If the system noise value is too high or too low, proceed to Receiver Noise Adjustment in Section 5.1.3.

5.1.3 Type 2 Receiver Gain Adjustment.

The Receiver gain is changed by adjusting a potentiometer (pot) that is accessed by removing a port-screw (labeled ***IF GAIN***) from the top panel of the Receiver. The pot is a surface mount device and is very small (the screw on the pot is about the size of a pinhead). A special alignment tool is provided with the Type 2 Receiver specifically for adjusting these pots and should always be kept at the site.

***** WARNING *****

Considerable care must be taken when making adjustments to the ***IF GAIN*** pot because it is delicate and extremely sensitive, rotations of just a few degrees will cause significant changes to the Receiver's gain.

1. Remove the blank panel located above the Receiver front panel from the front of the BSU Cabinet. (This will allow easier access to the gain adjustment pot.)

2. Carefully insert the alignment tool through the hole drilled in the center of the port-screw labeled IF GAIN on top of the Receiver, as shown in Figure 5-5. The pot may not be visible, so rely on the "feel" to seat the alignment tool on the potentiometer screw head.

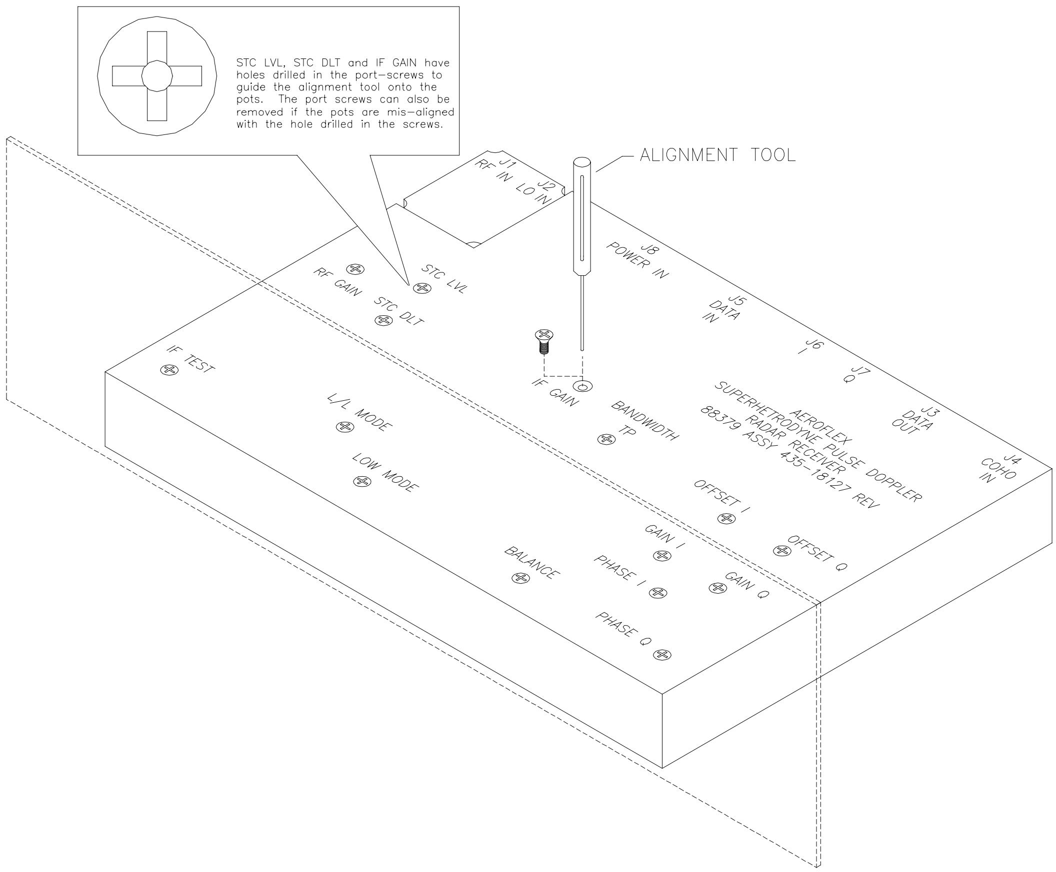


Figure 5-5 Type 2 Receiver Gain Adjustment

3. Adjusting the Receiver gain is a trial and error process. Make a small change to the IF GAIN pot, wait for the radar to cycle to the East beam, and use the PMT to verify the System Noise as described in Section 5.1.2. Repeat this process until the System Noise value of 063 ±1 is obtained. Once this value is reached, verify consistency of the System Noise value by checking several more continuous Beam cycles.

4. Replace the IF GAIN port-screw on the Receiver top panel.

5. Remove the 50 ohm load from RF INPUT (J1) on the rear panel of the Receiver, and connect the coaxial cable between J1 and the T/R Switch.

6. Contact the PCC at (303) 497-6033, and technicians will evaluate the data received from the profiler to determine if the factory STC settings will require adjustment.

5.1.4 Type 2 Receiver STC Alignment Procedure

The Sensitivity Time Control (STC) circuit is used to attenuate strong atmospheric signal returns that can saturate the Receiver in the three lowest range gates of the low modes. Receiver saturations cause a bias in the true atmospheric signals, and thus bias the wind measurements produced by the profiler.

The STC Alignment procedure requires an oscilloscope to monitor the waveform present at the In-phase (J6) or Quadrature (J7) output on the rear panel of the Type 2 Receiver. Triggering for the oscilloscope is obtained from one of two T/R Switch's gating pulses. The alignment procedure is performed when the radar is cycling normally in Operational mode during any of the three *Low* modes.

Test Equipment Setup

1. Power down the profiler using the standard power-down sequence described in Section 2.3.

2. Remove the four mounting screws from the front panel of the Signal Processor and pull the unit to its full out position. Remove the top cover panel from the Signal Processor.

3. Connect an oscilloscope-probe to Channel One of the oscilloscope. Unscrew the grabber-tip from the probe to expose the pointed tip. Insert the scope probe into pin 2 of connector J3 in the rear panel from inside the Signal Processor chassis, as shown in Figure 5-6.

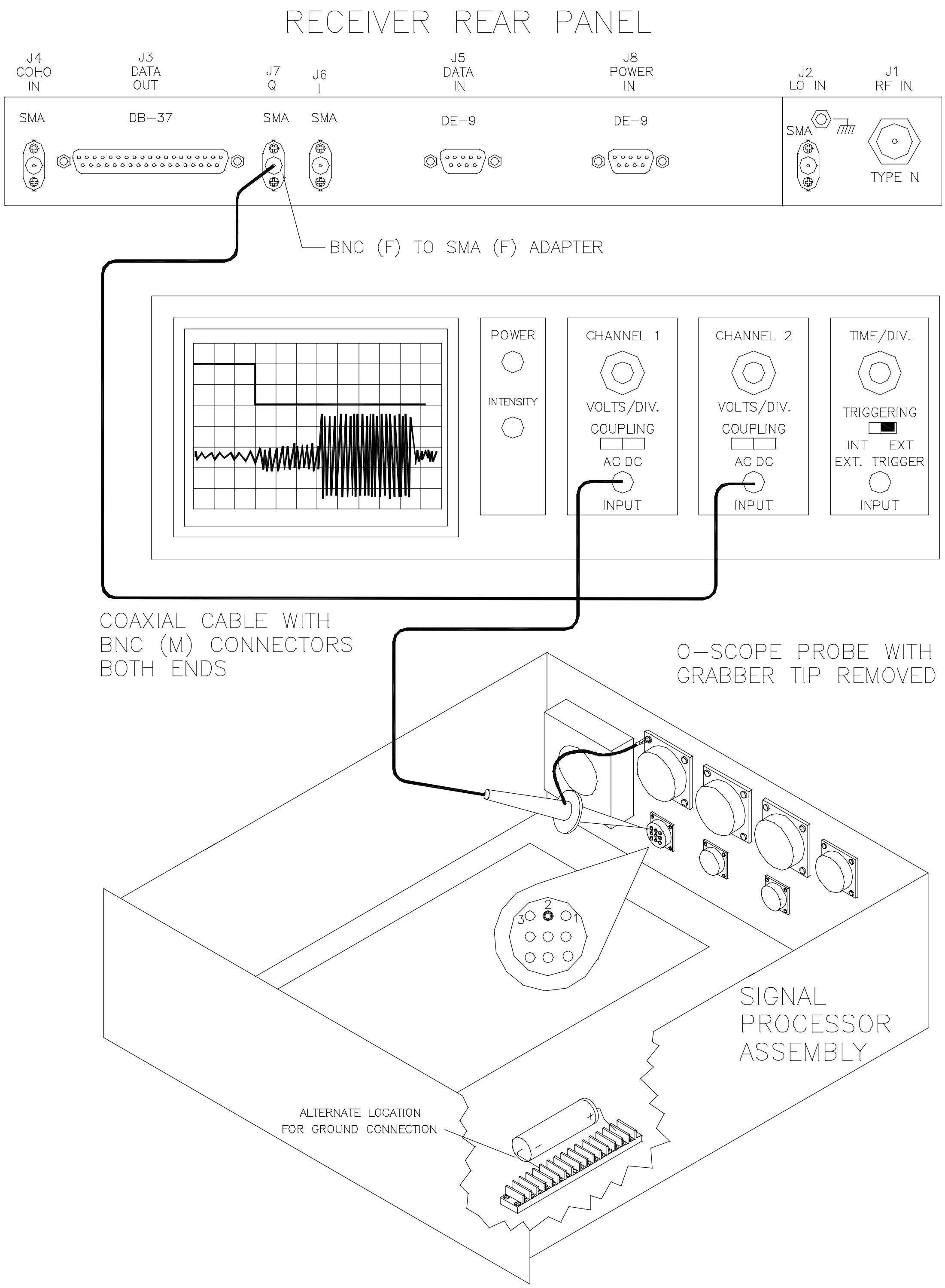


Figure 5-6 Receiver STC Alignment Test Equipment Setup

4. Screw an SMA (M) to BNC (F) adaptor onto connector J6 or J7 on the rear panel of the Type 2 Receiver. Connect a coax cable (with BNC connectors on both ends of cable) between Channel Two of the oscilloscope and the I (J6) or Q (J7) output on the rear panel of the Receiver as shown in Figure 5-6.

5. Oscilloscope Settings:

Time/Division:	5 uSec
Triggering:	Triggering on channel one - positive edge
Channel One:	Volts/Division = 2 (0.2 for X10 probe)
Channel Two:	Volts/Division = 200 mV

6. Terminate the RF INPUT (J1) on the Receiver rear panel with a 50 ohm load.

Procedure

1. Power up the Profiler using the sequence described in Section 2.4 and wait for the system to begin cycling normally.

2. With the Receiver's input (J1) terminated with a 50 ohm load, the oscilloscope will display waveforms similar to those shown in Figure 5-10. If the waveforms on the oscilloscope do not resemble those in Figure 5-7 and Figure 5-8, verify that the oscilloscope is triggering on pin 2 of connector J3 in the Signal Processor. The J3 connector may be rotated, and pin 2 may not be on top of the connector as it is shown in Figure 5-6.

   Figure 5-7 shows the entire T/R pulse referenced to the Receiver's video signal waveform. The oscilloscope is displaying the waveforms using a storage mode (trace over-writing) to enhance the characteristics of the video signal. The STC circuitry should be factory preset for ~8 microseconds delay (measured from the falling edge of trace 1) and 15 dB (~300 mV p-p) attenuation level. In reality, these settings must be fine-tuned on a site-by-site basis to achieve the maximum benefit from the STC circuitry.

3. Change the oscilloscope settings to 2 uSec/Division, and trigger on the falling edge of trace 1 (this will provide greater resolution on the oscilloscope screen). Figure 5-8 shows the falling edge of the T/R Switch gating signal (top trace) and the effect of the STC circuit on the video waveform (bottom trace). The STC is triggered off the falling edge of the gating signal and clamps the amplitude of the video signal several microseconds. The duration of the clamp is set by adjusting the *STC DLT* pot. The amplitude of the clamp is set by adjusting the *STC LVL* pot.

4. Contact the PCC to obtain the value required for the STC DLT duration setting.

Figure 5-7 STC Waveforms During the Low Mode, Rising Edge Trigger.

The top pulse in Figure 5-7 is the gating signal for the T/R Switch. The o-scope time/div is set at 5us to show the entire pulse. During the time when the signal is high, the T/R Switch blanks the receiver input. The bottom waveform shown is the video output of the Receiver (J7 or J8). The STC region starts at the falling edge of the T/R Pulse and extends out ~8us. The end of the STC region is where the video signal's amplitude jumps up.

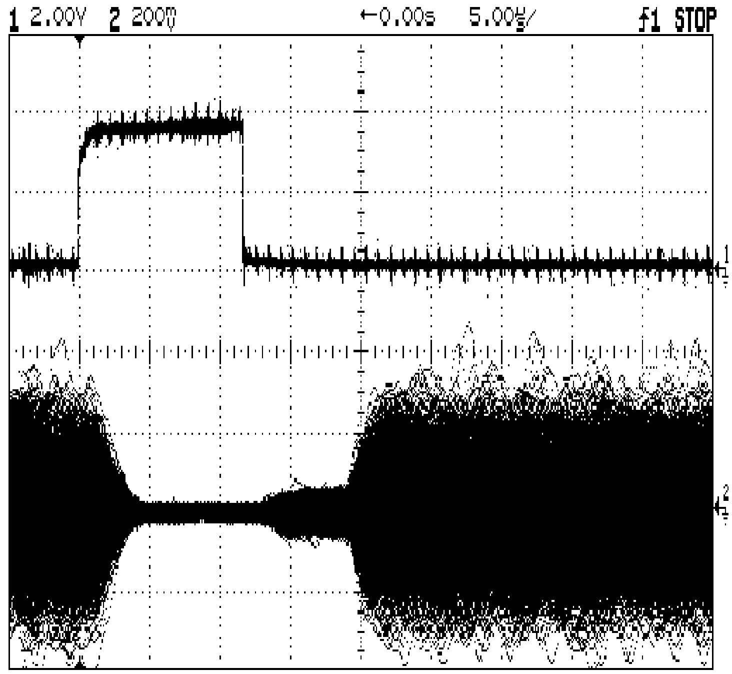
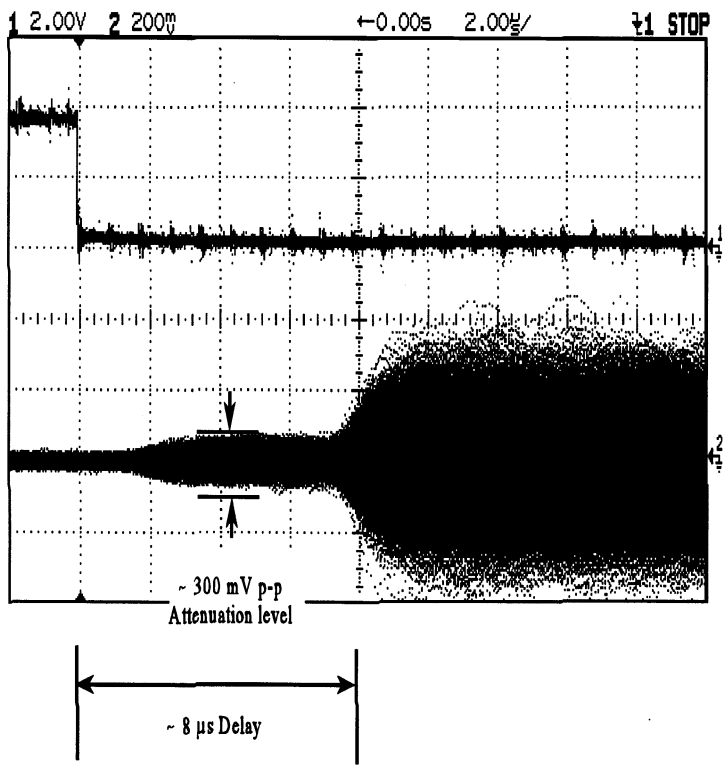


Figure 5-8 STC Waveforms During the Low Mode, Falling Edge Trigger.

These are the same waveforms as shown in Figure 5-7, except, triggering is on the falling edge of the T/R pulse, and time/div is set at 2us to expand more of the STC region. Nominally, the duration of the STC region should be adjusted to ~8us, and the amplitude of the STC region is adjusted between 300-800 mV p-p. Every site is different, additional adjustment to the STC LVL is required to optimize the STC circuitry.



***** WARNING *****

The port-screws covering the *STC LVL* and *STC DLT* pots (should) have small holes drilled through the center of the screws. These holes (should) guide the alignment tool onto the pot. Considerable care must be taken when making adjustments to the *STC DLT* and *STC LVL* pots, they are extremely delicate. Do not attempt to adjust these pots without the special alignment tool and an oscilloscope.

***** NOTE *****

To adjust the STC Delay, carefully insert the alignment tool through the hole drilled in the port-screw of the *STC DLT* port on top of the Receiver (refer to Figure 5-5).

Rotate **CW** to Decrease the delay duration
Rotate **CCW** to Increase the delay duration

To adjust the STC Level, carefully insert the alignment tool through the hole drilled in the port-screw of the *STC LVL* port on top of the Receiver (refer to Figure 5-5).

Rotate **CW** to Increase the signal
Rotate **CCW** to Decrease the signal

5. Adjust the *STC DLT* pot on the top of the Receiver, observe the video signal on the oscilloscope. The length of the delay should vary with changes of the pot. Adjust the STC duration to ~ 8 uSec. This step will verify that the test equipment is connected correctly, and that turning the *STC DLT* pot will in fact change the STC delay settings.

6. Remove the 50 load from RF INPUT (J1) on the Receiver rear panel and connect the coaxial cable between the T/R Switch and J1 on the Receiver.

7. Contact the PCC at (303) 497-6033 and work with the support technicians to fine-tune the STC LVL and STC DLT settings. Fine-tuning the STC can be a time-consuming process, occasionally taking several hours of evaluation and adjustment to optimize the STC settings for a given site.

8. Once the STC alignment is completed, disconnect the test equipment from the radar, put the cover back on the Signal Processor, and slide the unit back into the rack.

9. Reinstall the blank panel above the Receiver front panel, and reinstall the BSU Cabinet side panel.

5.2 Limiter

The Limiter is located in the BSU Cabinet above the Receiver Assembly (see Figure 5-2). The Limiter is designed to protect the T/R Switch and Receiver Assembly from being damaged by excessive reflected power levels induced by antenna or BSU failures.

Replacement Procedure

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the side panel from the BSU Cabinet (see Figure 5-2).

3. Unscrew the type "N" connector between the T/R Switch and the Limiter, and disconnect the T/R Switch from the Limiter (see Figure 5-9).

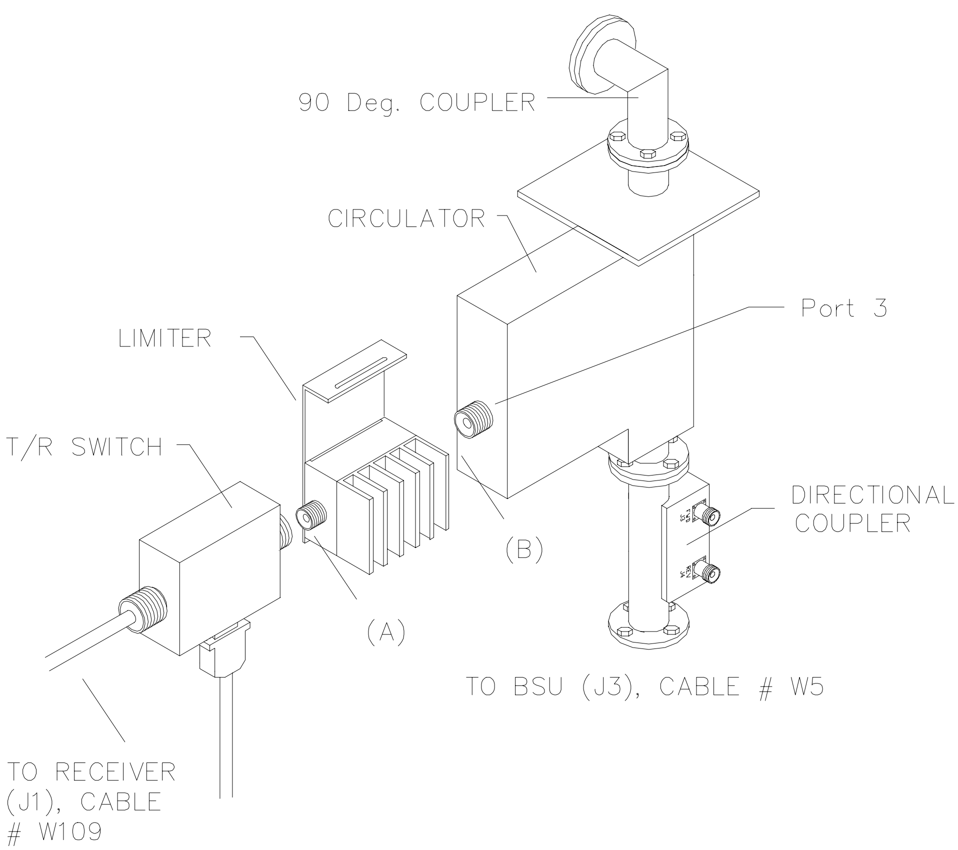


Figure 5-9 Limiter Replacement

4. Remove the bolts that fasten the Limiter mounting bracket to the BSU Cabinet top panel.

5. Unscrew the type "N" connector between the Limiter and the Circulator and remove the Limiter from the BSU Cabinet.

6. Loosen the four screws on the mounting bracket of the new Limiter.

7. Connect the new Limiter to the Circulator.

8. Fasten the Limiter mounting bracket to BSU Cabinet top panel.

9. Tighten the four screws on the mounting bracket of the new Limiter.

10. Connect the T/R Switch to the Limiter.

11. Reinstall the side panel on the BSU Cabinet.

12. Follow the standard power-up sequence described in Section 2.4.

5.3 Transmit/Receive Switch

The Transmit/Receive (T/R) switch is located in the BSU cabinet above the Receiver Assembly (see Figure 5-2). The T/R switch isolates the Receiver during the radar pulse transmission to protect the first stage of the Receiver Assembly from damage. As such, it functions with the Coaxial Circulator as a duplexer, allowing the profiler antenna to be used for both transmission and reception.

Transmit/Receive Switch Replacement Procedure

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the side panel from the BSU Cabinet (see Figure 5-2).

3. Using a small screwdriver, remove the retaining screws from the DE-9 connector on cable #W5 [point (A) in Figure 5-10] and remove the connector from the bottom of the T/R Switch.

4. Remove cable #W109 from the output of the T/R Switch [point (B) in Figure 5-10].

5. Loosen the type "N" connector that attaches the T/R Switch directly to the Limiter [point (C) in Figure 5-10] and remove the T/R Switch from the BSU Cabinet.

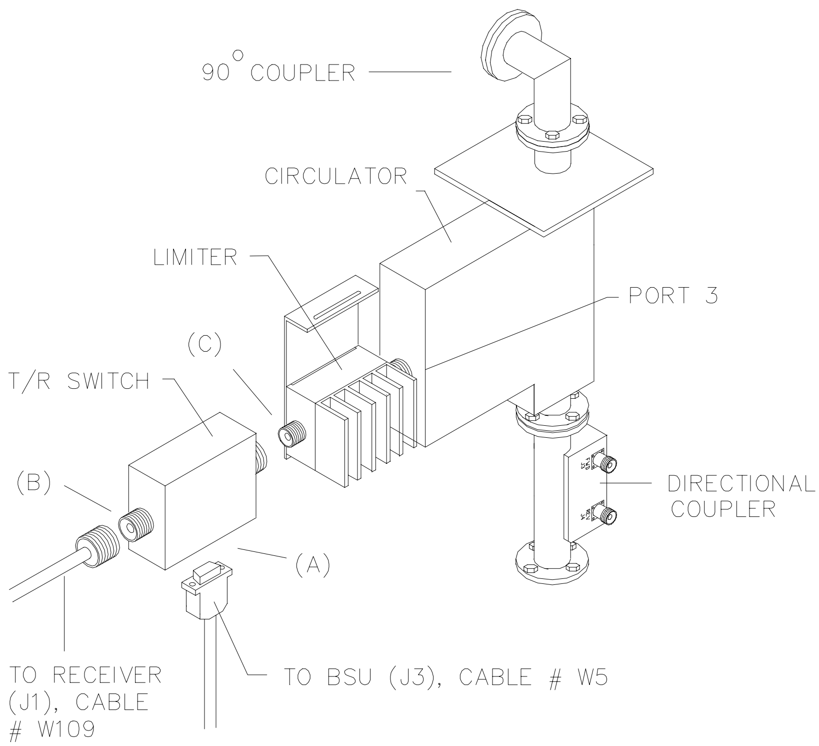


Figure 5-10 Transmit/Receive (T/R) Switch Replacement

6. Install the new T/R Switch in the BSU Cabinet and tighten the type "N" connector between the T/R Switch and the Limiter.

7. Reconnect cable #W109 to the output of the T/R Switch and tighten the connector.

8. Reconnect control cable #W5 to the bottom of the T/R Switch by re-attaching the DE-9 connector and fastening the retaining screws with a small screwdriver.

9. Replace the side panel on the BSU Cabinet.

10. Follow the standard power-up sequence described in Section 2.4.

5.4 Circulator

The Coaxial Circulator is bolted to the top of the BSU Cabinet and physically connected to the Directional Coupler Assembly (see Figure 5-2). The Circulator is a three-port, non-reciprocal device. It passes energy from the RF Power Amplifier (port 1) to the radar's coaxial co-linear antenna (port 2) with little attenuation while isolating the Receiver (at port 3). It also allows return signals from the antenna (port 2) to flow to the receiver (port 3) with little attenuation. Any residual power that appears at the first stage of the Receiver (port 3) is isolated by the actions of the Limiter and T/R Switch.

5.4.1 Circulator Replacement Procedure

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the side panel of the BSU Cabinet (see Figure 5-11).

3. Remove the mounting screws that attach the Limiter mounting bracket to the top of the BSU Cabinet (see Figure 5-11).

4. Disconnect cable #W109 from port J1 on the rear panel of the Receiver and terminate J1 with a 50-ohm Load.

5. Disconnect the Limiter and T/R switch from port 3 of the Circulator [point (A) in Figure 5-11] by unscrewing the type "N" connector. Place the Limiter and T/R Switch on top of the Receiver.

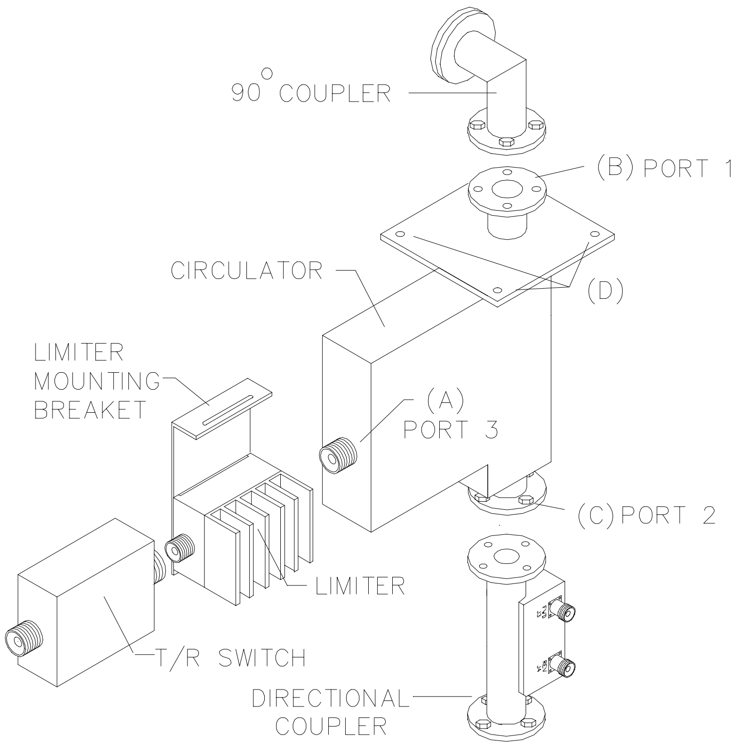


Figure 5-11 Circulator Replacement

6. Unplug the Inside Temperature Sensor (thermocouple) from its receptacle in the top of the BSU Cabinet (see Figure 2-4) and place it on the workbench.

7. Disconnect the thermocouple wires from the sensor receptacle and place them on top of the Receiver.

8. Remove the four bolts that fasten the top of the Circulator to the 900 Coupler [point (B) in Figure 5-11].

9. Remove the screws holding the top panel of the BSU Cabinet (see Figure 5-2).

10. Remove the bolts connecting the Circulator to the Directional Coupler [point (C) in Figure 5-11].

11. Grasp the Circulator firmly with both hands, lifting the Circulator and top panel of the BSU Cabinet straight up (as one assembly) to disconnect the Circulator from the Directional Coupler. Remove the assembly from the BSU Cabinet and place it on the floor of the shelter. Use care not to drop or jar the unit as the Circulator is easily damaged.

12. Remove the four bolts holding the top of the Circulator to the top panel of the BSU Cabinet [point (D) in Figure 5-11] and remove the Circulator.

13. Attach the new Circulator to the top panel of the BSU Cabinet and fasten the mounting bolts.

14. Lift the Circulator/BSU top panel assembly and place it on top of the BSU Cabinet.

15. Reach into the BSU Cabinet from the side and grasp the Circulator firmly with both hands.

16. Align port 2 of the Circulator [point (C) of Figure 5-11] with the center conductor of the Directional Coupler, and lower the Circulator straight down so that the center conductor is inside the Circulator. Rotate the Circulator flange so that the hole in the flange aligns with the pin on the Directional Coupler flange.

17. Fasten the four bolts connecting the Circulator to the Directional Coupler [point (C) in Figure 5-11].

18. Replace the screws that fasten the top panel to the BSU Cabinet.

19. Reconnect the thermocouple wires to the sensor receptacle.

20. Plug the Inside Temperature Sensor into its receptacle at the top of the BSU Cabinet.

21. Replace the four bolts that fasten the top of the Circulator to the 900 Coupler.

22. Test the power levels at port 3 of the Circulator using the procedures described in Section 5.4.2.

23. Reconnect the T/R Switch and Limiter to port 3 of the Circulator and tighten the type "N" connector [point (A) in Figure 5-11].

24. Remove the 50-ohm Load terminating port J1 and reconnect cable #W109.

25. Replace the side panel of the BSU Cabinet.

26. Follow the standard power-up sequence described in Section 2.4.

5.4.2 Circulator Port 3 Power Levels Test Procedure

The Circulator port 3 power level test measures the performance of the Circulator. This test is performed when any component in the BSU Cabinet is replaced or suspected of being faulty.

Test equipment required for this procedure is as follows:

- HP8900D Peak Power Meter
- HP84811A Peak Power Sensor
- HP8401A 10-dB Attenuator
- 100 MHZ Oscilloscope
- Two RG-8 coaxial cables with male type "N" connectors
- Pasternak Model PE7021 40-dB Attenuator, 100-watt (average power)
- Two RG-58 coaxial cables with male BNC connectors

The test equipment setup for this procedure is illustrated in Figure 5-12.

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the side panel of the BSU Cabinet (see Figure 5-2).

3. Disconnect cable #W109 from port J1 on the rear panel of the Receiver and terminate port J1 with a 50-ohm Load.

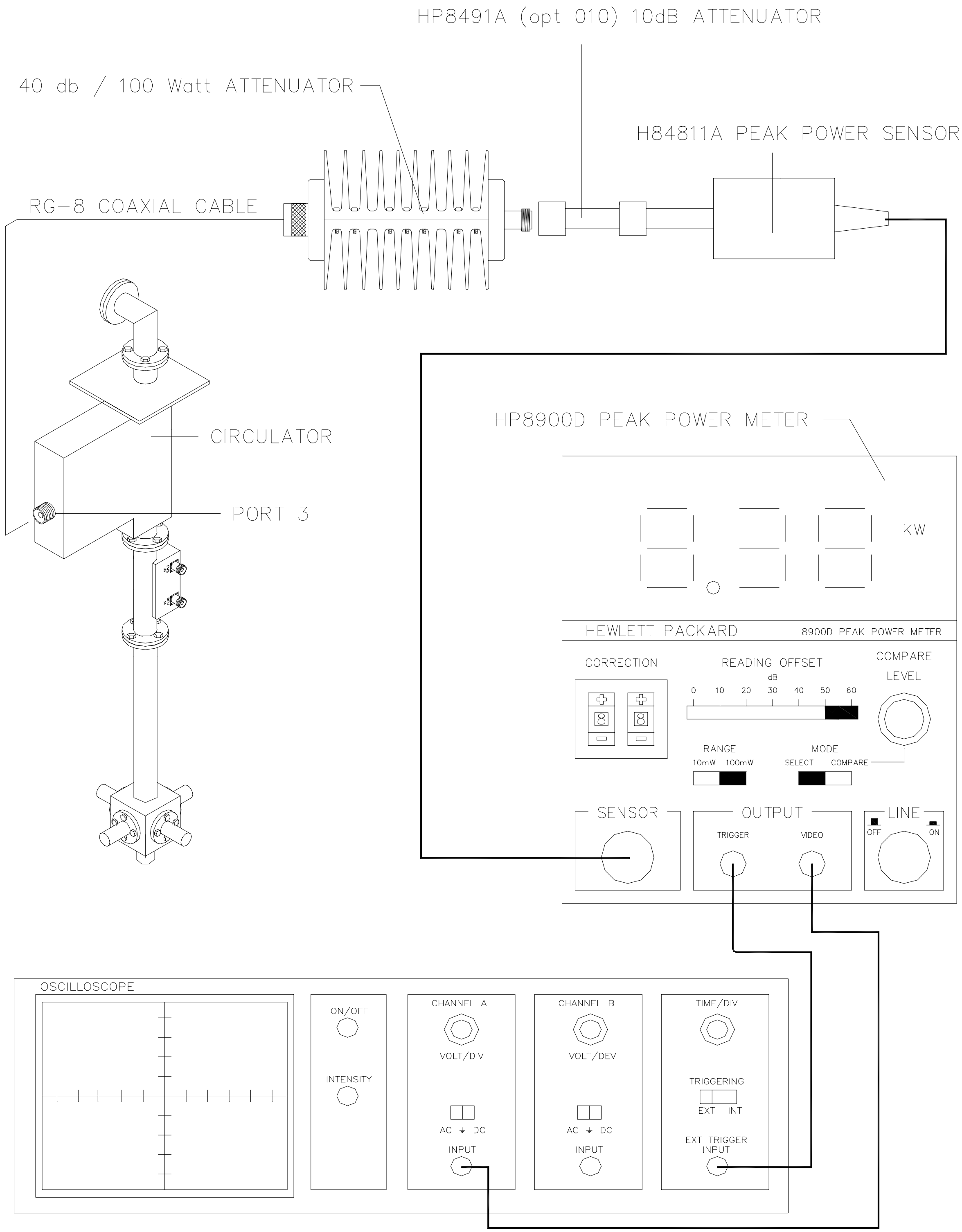


Figure 5-12 Circulator Port 3 Power Test Equipment Setup

4. Remove the mounting screws that attach the Limiter mounting bracket to the top of the BSU Cabinet (see Figure 5-11).

5. Disconnect the Limiter and T/R switch from port 3 of the Circulator [point (A) in Figure 5-11] by unscrewing the type "N" connector. Place the Limiter and T/R Switch on top of the Receiver.

6. Assemble the test equipment as illustrated in Figure 5-12. Connect one end of an RG-8 coaxial cable to port 3 of the Circulator, and connect the other end of the cable to the INPUT port of the 40-dB attenuator. Connect the 10-dB attenuator to the OUTPUT port of the 40-dB attenuator. Connect the HP84811A Peak Power Sensor to the 10-dB attenuator. Connect the Peak Power Sensor to the HP8900D Peak Power Meter. Connect the VIDEO OUTPUT of the HP8900D to Channel One of the oscilloscope with a BNC (M) to BNC (M) coaxial cable. Connect the TRIGGER OUTPUT of the HP8900D to the EXTERNAL TRIGGER INPUT of the oscilloscope with a BNC (M) to BNC (M) coaxial cable.

7. HP8900D Peak Power Meter settings:

READING OFFSET	50-dB
RANGE	10 mW, 100 mW if over range occurs
MODE	COMPARE
CORRECTION FACTOR	As marked on the 84811A Peak Power Sensor for range nearest to 400 MHz

8. Oscilloscope Settings:

VOLTS/DIVISION	5 mV/Div
TIME/DIVISION	5 uSec/Div
TRIGGER SOURCE	EXTERNAL - RISING EDGE

9. Follow the standard power-up sequence described in Section 2.4.

10. Permit the radar to enter its normal operational cycle.

11. Observe the waveforms on the oscilloscope screen. Adjust the COMPARE knob on the HP8900D so the DC level of the *compare trace* on the scope is positioned at the top of the transmitted pulse, averaging through any ripples. (The waveform will be similar to those shown in Figure 5-17 and Figure 5-18.)

12. Record the readings of the Peak Power Meter in each beam and mode. If the measured peak power is less than 350 Watts in all beams and modes, the Circulator is functioning properly.

> ***** NOTE *****
>
> If any of the readings are out of specification, check the test equipment setup and repeat the measurements if the setup is found to be in error. If the setup is correct, contact the PCC for assistance.

13. Reconnect the Limiter and T/R switch to port 3 of the Circulator.

14. Replace the mounting screws that attach the Limiter mounting bracket to the top of the BSU Cabinet.

15. Remove the 50-ohm Load from port J1 on the rear panel of the Receiver and reconnect cable #W109 at this point.

16. Replace the side panel of the BSU Cabinet.

17. Follow the standard power-up sequence described in Section 2.4.

5.5 Directional Coupler

The Directional Coupler is a passive device connected to the Circulator and 5-Way Power Divider as illustrated in Figure 5-2. This component has two ports that allow antenna forward and reflected power measurements to be made. The Forward and Reflected Power ports of the Directional Coupler have internal 50 dB attenuation factors.

Directional Coupler Replacement Procedure

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the side panel from the BSU Cabinet (see Figure 5-2).

3. Remove the mounting screws that attach the Limiter mounting bracket to the top of the BSU Cabinet.

4. Disconnect cable #W109 from port J1 on the rear panel of the Receiver and terminate port J1 with a 50-ohm Load.

5. Disconnect the Limiter and T/R switch from port 3 of the Circulator by unscrewing the type "N" connector. Place the Limiter and T/R Switch on top of the Receiver.

6. Remove the screws from the top panel of the BSU Cabinet (see Figure 5-2).

7. Unscrew the type "N" connectors from the forward and reflected power ports on the Directional Coupler [points (A) & (B) in Figure 5-13] and remove the 3-dB pads.

8. Remove the four bolts that fasten the bottom of the Circulator to the Directional Coupler [point (C) in Figure 5-13].

9. Grasp the Circulator firmly with both hands, lifting the Circulator (still connected to the top panel of the BSU Cabinet) straight up to disconnect the Circulator from the Directional Coupler. Move the Circulator and top panel of the BSU Cabinet to the side and place it on the top frame of the BSU Cabinet. Use care not to drop or jar the unit as the Circulator is easily damaged.

10. Remove the four bolts that fasten the Directional Coupler to the 5-Way Power Divider [point (D) in Figure 5-13].

11. Grasp the Directional Coupler with one hand while holding the 5-Way Power Divider with the other, and lift the Directional Coupler straight up to disconnect it from the 5-Way Power Divider. Remove the Directional Coupler from the BSU Cabinet.

12. Align the axis of the new Directional Coupler with the center conductor of the 5-Way Power Divider [point (D) of Figure 5-13] and lower the Directional Coupler straight down so that the center conductor of the 5-Way Power Divider fits inside the Directional Coupler. Rotate the Directional Coupler flange so that the hole in the Directional Coupler flange aligns with the pin on the 5-Way Power Divider flange.

13. Replace the four bolts that fasten the Directional Coupler to the 5-Way Power Divider.

14. Align port 2 of the Circulator [point (C) of Figure 5-13] with the center conductor of the Directional Coupler, and lower the Circulator straight down so that the center conductor is inside the Circulator. Rotate the Circulator flange so that the hole in the flange aligns with the pin on the Directional Coupler flange.

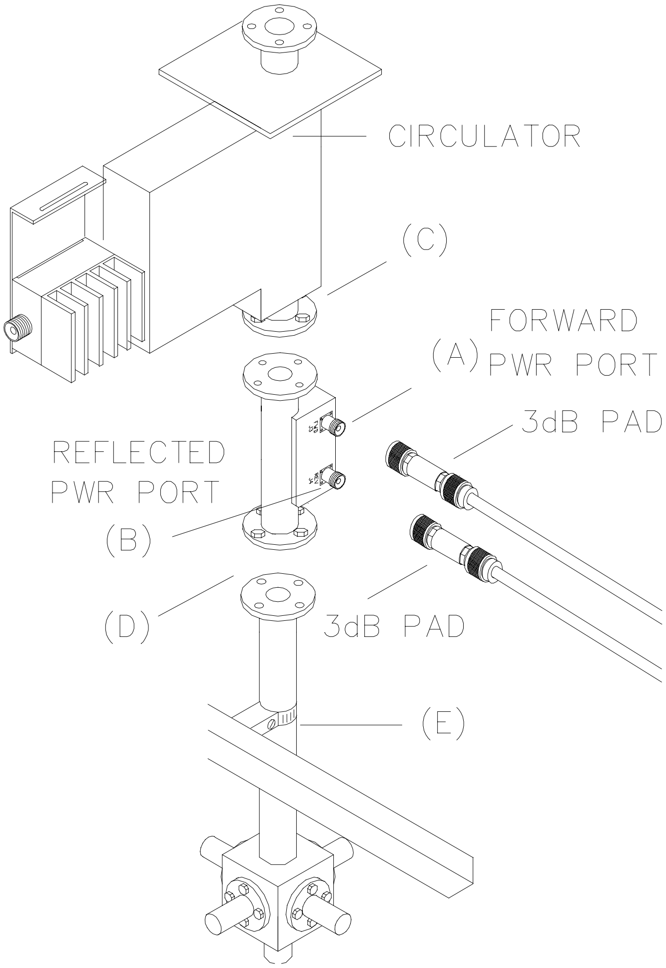


Figure 5-13 Directional Coupler Replacement

15. Replace the four bolts that fasten the bottom of the Circulator to the Directional Coupler.

16. Replace the screws holding the top panel of the BSU Cabinet.

17. Reconnect the 3-dB pads to the forward and reflected power ports of the Directional Coupler and fasten their type "N" connectors.

18. Perform the Circulator Port 3 Power Levels Test Procedure described in Section 5.4.2.

19. Reconnect the T/R Switch and Limiter to port 3 of the Circulator and tighten the type "N" connector.

20. Replace the mounting screws that attach the Limiter mounting bracket to the top of the BSU Cabinet.

21. Remove the 50-ohm Load terminating port J1 and reconnect cable #W109 to that point.

22. Replace the side panel of the BSU Cabinet.

23. Follow the standard power-up sequence described in Section 2.4.

5.6 5-Way Power Divider

The 5-Way Power Divider splits the RF power from the transmitter into five equal parts and sends each portion to a BSU Switch in the BSU Switch Assembly. Figure 5-2 identifies the location of the 5-Way Power Divider in the BSU Cabinet.

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the side panel of the BSU Cabinet.

3. Disconnect cable #W109 from port J1 on the rear panel of the Receiver and terminate port J1 with a 50-ohm Load.

4. Disconnect the Limiter and T/R switch from port 3 of the Circulator [point (A) in Figure 5-14] by unscrewing the type "N" connector. Place the Limiter and T/R Switch on top of the Receiver.

5. Unscrew the type "N" connector on each of the five Power Distribution Cables and remove that end of the cable from a BSU Switch (see Figure 5-23).

6. Note the connections between the Phase Delay Cables and the 5-Way Power Divider before removing the cables. Phase Delay Cables must be replaced in their original positions, and the ports on the 5-Way Power Divider are not labeled.

   Unscrew the three bolts holding each Phase Delay Cable to the 5-Way Power Divider [point (A) in Figure 5-14] and remove that end of the cable. Ensure that the center conductor of each connector is removed with the Phase Delay Cable. If a center conductor remains attached to the 5-Way Power Divider, remove the conductor and insert it into the Phase Delay Cable connector.

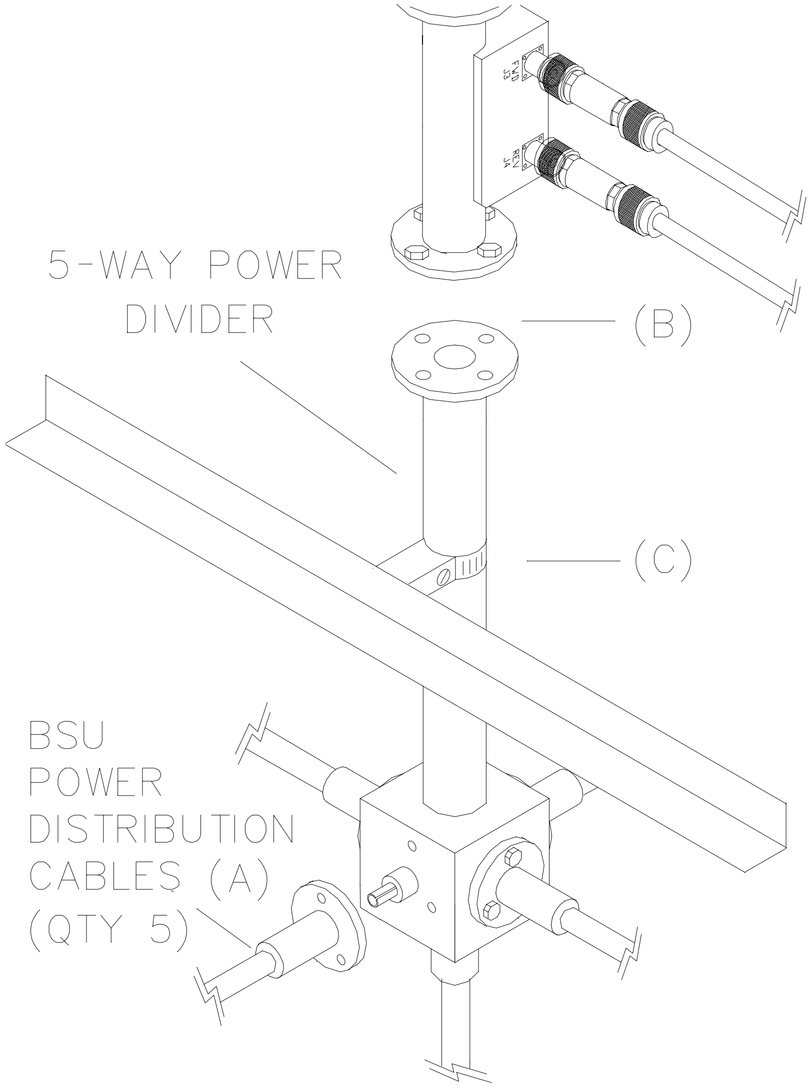


Figure 5-14 5-Way Power Divider Replacement

7. Loosen and remove the clamp that fastens the shaft of the 5-Way Power Divider to the BSU Cabinet cross brace [point (C) in Figure 5-14].

8. Loosen the four bolts that fasten the 5-Way Power Divider to the Directional Coupler [point (B) in Figure 5-14], and remove all but one bolt.

Firmly support the shaft of the 5-Way Power Divider with one hand and use the other to remove the last bolt. Do not let the 5-Way Power Divider fall on the BSU Switch below.

9. Pull the 5-Way Power Divider straight down to separate it from the Directional Coupler. Note the center conductor that is normally attached to the 5-Way Power Divider, may remain with the Directional Coupler after the units are separated.

10. Insert the center conductor into the shaft of the new 5-Way Power Divider.

11. Remove the gasket from the shaft of the old 5-Way Power Divider and place it on the new unit.

12. Insert one bolt through the flange of the Directional Coupler. Align the flanges of the two units so that the bolt passes through a hole in the 5-Way Power Divider flange and the center conductor fits into the Directional Coupler. Place a nut on the bolt to prevent the 5-Way Power Divider from falling on the BSU Switch while the other bolts are secured.

13. Install and tighten the clamp that secures the shaft of the 5-Way Power Divider to the BSU Cabinet cross brace.

14. Connect the Phase Delay Cable that was originally connected to the bottom port of the 5-Way Power Divider. Install the fastening bolts and tighten them evenly. Repeat this procedure for the remaining four Phase Delay Cables.

15. Connect the Phase Delay Cables to their original positions on the BSU Switch Assembly.

16. Perform the Circulator port 3 power level test procedure described in Section 5.4.2.

17. Reconnect the T/R Switch and Limiter to port 3 of the Circulator and tighten the type "N" connector.

18. Replace the mounting screws that attach the Limiter mounting bracket to the top of the BSU Cabinet.

19. Remove the 50-ohm Load terminating port J1 on the back panel of the Receiver and reconnect cable #W109 to J1.

20. Replace the side panel of the BSU Cabinet.

21. Follow the standard power-on sequence described in Section 2.4.

5.7 Reflected Power Sensor

The Narda 481 Reflected Power Sensor; located inside the BSU Cabinet is mounted on a cross brace as illustrated in Figure 5-2. The sensor detects the reflected power from the antenna and transmits a proportional voltage to System Status Monitor. If the DC voltage transmitted to the SSM is out of range, the status monitor interprets this as a voltage standing wave ratio (VSWR) fault and shuts down the radar transmitter, rendering the site inoperative.

5.7.1 Reflected Power Sensor Replacement Procedure

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the side panel of the BSU Cabinet.

3. Unscrew and remove the type "N" connector from the top of the Reflected Power Sensor [point (A) in Figure 5-15].

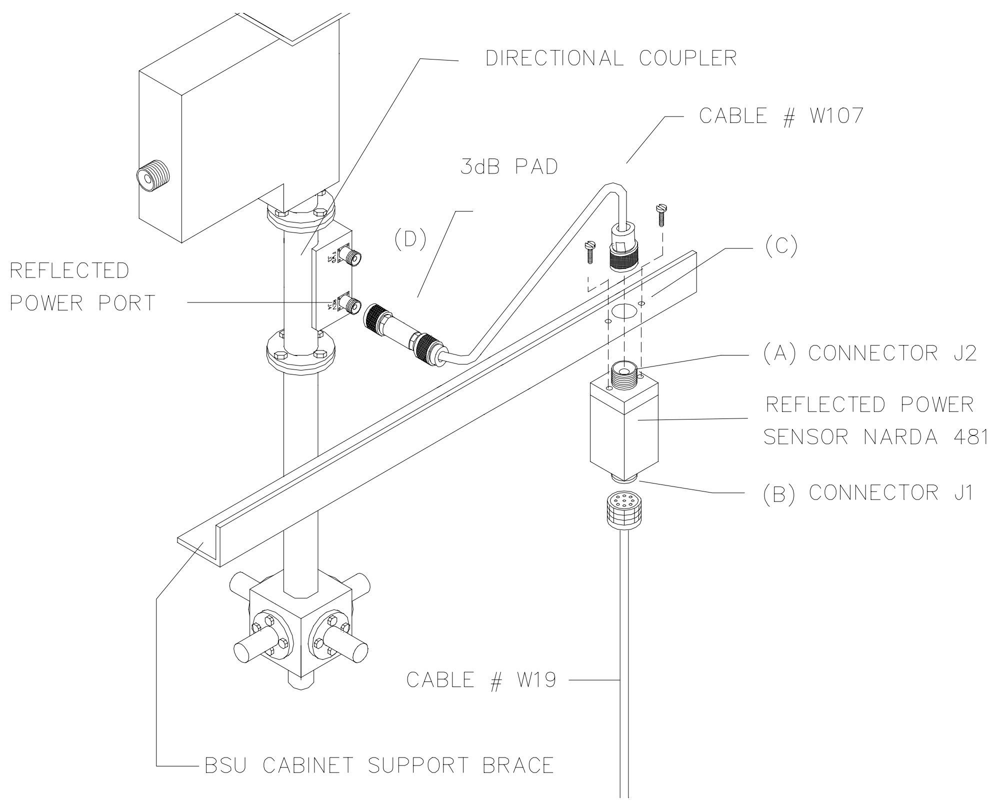


Figure 5-15 Reflected Peak Power Sensor Replacement

4. Unscrew and remove the military style connector from the bottom of the Reflected Power Sensor [point (B) in Figure 5-15].

5. Remove the mounting screws and remove the sensor [point (C) in Figure 5-15].

6. Install the new Reflected Power Sensor and fasten it in place with the mounting screws.

7. Replace the type "N" connector at the top of the sensor.

8. Replace the military-style connector to the bottom of the sensor.

5.7.2 Reflected Power Sensor Calibration Procedure

The Reflected Power Sensor must be calibrated after replacement. The steps required for calibration include zero-offset adjustment, test equipment setup, power measurement, sensor output calculation, and sensor output calibration. Test equipment required to perform these activities is as follows:

- HP8900D Peak Power Meter
- HP84811A Power Sensor
- Digital Volt Meter (DVM)

The Test equipment setup for this procedure is shown in Figure 5-16.

5.7.2.1 Reflected Power Sensor Zero Offset Adjustment

1. Disconnect the 3-dB pad and cable #W107 from the reflected power port on the Directional Coupler [point (D) in Figure 5-16].

2. Remove the four mounting screws from the front panel of the System Status Monitor and pull the unit to its full-out position. Remove the top cover panel of the SSM.

3. Connect the DVM between test points TP8(+) and TP14(GND) of the Analog Interface Board (Figure 5-19) inside the SSM chassis.

4. Turn on Breaker #22 to restore power to the Equipment Cabinet.

5. Adjust R24 on the SSM Analog Interface Board for 0 VDC (± 10mV).

6. Turn off Breaker #22 to remove power from the Equipment Cabinet.

5.7.2.2 Test Equipment Setup

***** CAUTION *****

Measurements and adjustments are made at full RF power. To avoid encountering HIGH POWER RF, care must be taken to disconnect the correct cables.

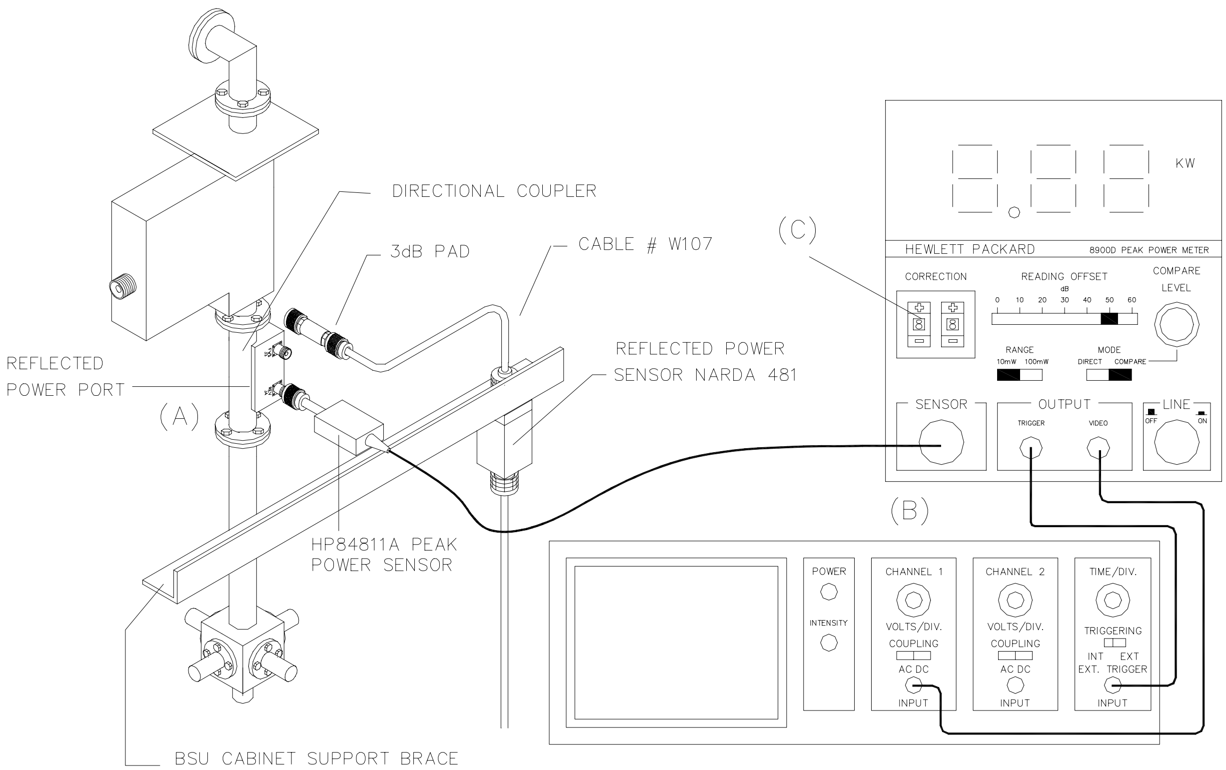


Figure 5-16 Reflected Power Measurement Test Equipment Setup

1. Connect HP84811A Power Sensor to the REV (reflected) power port of the Directional Coupler as illustrated in Figure 5-16.

2. Connect the output cable of the Power Sensor to the SENSOR input of the HP8900D Peak Power Meter [point (B) in Figure 5-16].

3. Note the correction factor for the 400-MHZ range on the Power Sensor and dial it into the CORRECTION switches on the front panel of the Peak Power Meter [point (C) in Figure 5-16].

4. Set the READING OFFSET on the Peak Power Meter to "50-dB", set the MODE to "DIRECT", and set the RANGE to "10 mW". If an over range condition occurs during measurements, change the range to "100 mW".

5. Power up the system by following the standard power up sequence in Section 2.4.

5.7.2.3 Reflected Peak Power Measurement

The profiler spends two minutes in each of its three beams (east, north, and vertical): one minute in the high mode and then one minute in the low mode. All power measurements and adjustments must be made in the same beam and mode to ensure the consistency of the measurements.

Observe the front panel of the Beam Steering Unit to determine when the profiler is in a particular beam and mode. When the radar switches beams, one minute remains to make measurements or adjustments in high mode before it switches to low mode using the procedures described below. If measurements or adjustments cannot be made in the selected one minute period, wait until the next time the radar switches into the desired beam and mode.

1. Let the profiler transmit through one complete beam cycle (East High through Vertical Low). During this time observe the reading of the Peak Power Meter, and determine which beam and mode produces the highest measurable power level.

2. Switch the RANGE switch on the Peak Power Meter from DIRECT to COMPARE mode.

3. When the profiler is transmitting in the beam and mode that produced the highest measurable power, observe the waveforms on the oscilloscope. Rotate the COMPARE LEVEL knob on the HP8900D to position the compare trace at the top of the transmitted pulse waveform, averaging through any ripples. Figure 5-17 and Figure 5-18 are examples of transmitted pulses in the high and low modes respectively. The compare traces in these figures have been positioned correctly. Record the peak power value displayed on the HP8900D (referenced below as $P_{measured}$).

5.7.2.4 Reflected Power Sensor Output Calculation

Calculate the Reflected Power Sensor output voltage at a given power level using Equation (5-1) and record the result for later use in the calibration of the sensor.

$$V_{out} = (P_{measured} * 10) / 4 \qquad (5\text{-}1)$$

Figure 5-17 20 us Peak Power Pulse in High Mode

Waveform displayed on an oscilloscope when used in conjunction with an HP8900D peak power meter. The vertical position of the **Compare Trace** is varied by rotating the *Compare* knob on the HP8900D.

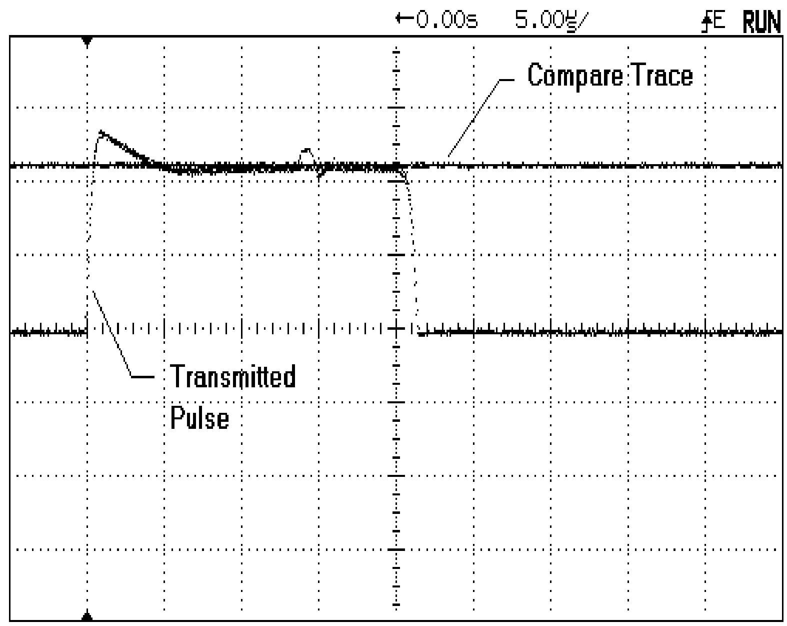
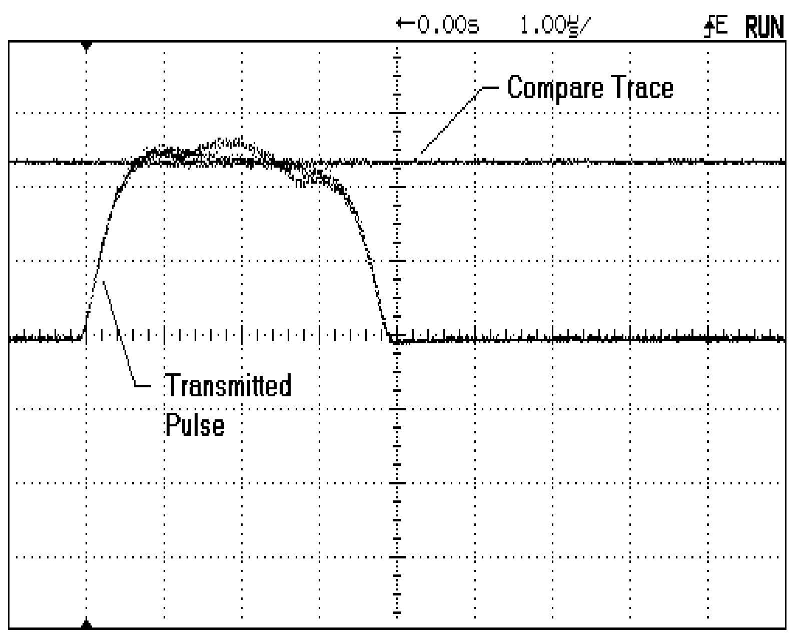


Figure 5-18 3.33 us Peak Power Pulse in Low Mode

Waveform displayed on an oscilloscope when used in conjunction with an HP8900D peak power meter. The vertical position of the **Compare Trace** is varied by rotating the *Compare* knob on the HP8900D.



where: V_{out} = Reflected Power Sensor output voltage measured between TP8(+) and TP14(-) of the SSM Analog Interface Board.

$P_{measured}$ = Actual Power calculated using equation 5-1

Example: Calculate V_{out} when $P_{measured}$ = 0.191 KW.

(0.191 * 10) / 4 = 0.4775 VDC.

5.7.2.5 Reflected Power Sensor Calibration

1. Remove the test equipment and reconnect the Reflected Power Sensor to the reflected power port on the Directional Coupler.

2. Connect the DVM between test points TP8(+) and TP14(GND) on the SSM Analog Interface Board (see Figure 5-19).

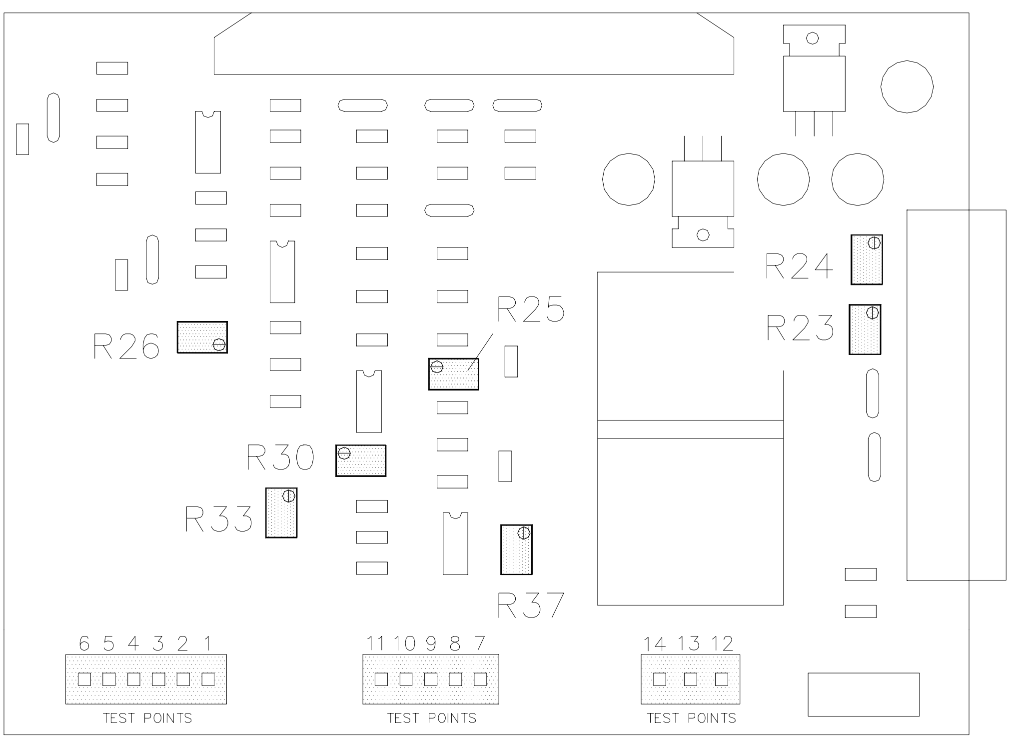


Figure 5-19 System Status Monitor Analog Interface Board

3. With the profiler in operational mode, and transmitting in the same direction and mode used to calculate the Reflected Power Sensor output, adjust the calibration potentiometer on the Reflected Power Sensor to produce a DC voltage corresponding to the result obtained using Equation (5-1).

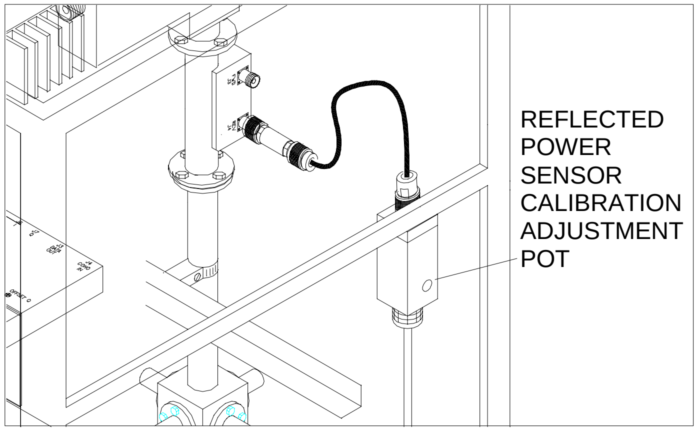


Figure 5-20 Reflected Power Sensor Calibration Adjustment Pot

4. The Reflected Power Sensor calibration potentiometer is exposed by removing the metallic plug from the side of the sensor housing (see Figure 5-20). Use a small flat-blade screwdriver to make the adjustment and calibrate the sensor.

Completion Activities

1. Replace the plug on the side of the Reflected Power Sensor.

2. Replace the side panel of the BSU Cabinet.

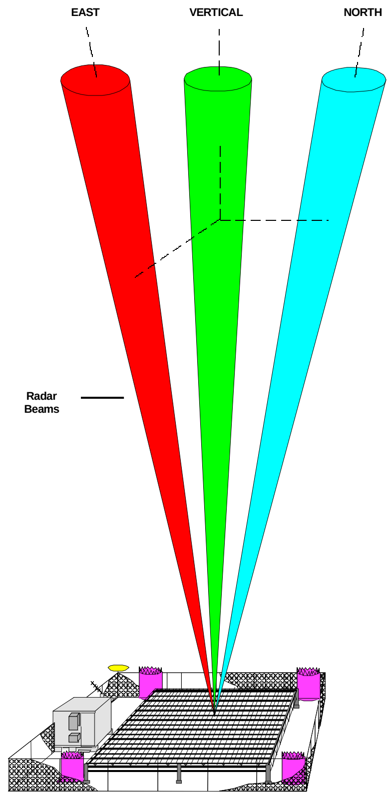
3. Replace the top cover of the SSM.

4. Push the SSM back into the Equipment Cabinet and replace the mounting screws on the front panel.

5. Contact the Profiler Control Center to verify that the Reflected Power Sensor calibration and replacement have been successfully accomplished.

5.8 Type 2 404 MHz Beam Steering Unit (BSU) Switch Assembly

The BSU Switch Assembly routes RF energy to one of two Co-Axial Co-Linear (COCO) antenna arrays. The two antenna arrays are othogonal to one another. The upper COCO antenna array comprises the East Beam. The lower COCO antenna array comprises both the North and Vertical Beams. The oblique beams (east and north) propagate RF energy into the atmosphere at an angle of 73.7-degrees above the horizon. The angle of propagation is determined by the length-ratio of the five Power Distribution Cables (see Figure 5-21). The BSU Switch Assembly contains five Phase Delay Cables.



The lengths of the Phase Delay Cables are complimentary to the lengths of the Power Distribution Feed Cables. During the Vertical Beam, the BSU routes RF energy through the Phase Delay Cables, effectively making the lengths of the five Power Distribution Cables equal. When the Phase Delay Cable lengths are equal, the antenna propagation angle changes to 90-degrees above the horizon.

The BSU accepts beam position commands from the Signal Processor, selects the Upper Antenna Sub-Array (for the East beam) or the Lower Antenna Sub-Array (for the North and Vertical beams), and routes RF energy through the Phase Delay Cables (for the Vertical beam) during the transmission cycle. Figure 5-2 identifies the location of the BSU Switch Assembly in the BSU Cabinet. Figure 5-22 shows the BSU front panel *BEAM DIRECTION* indicators and switch *FAULT LOCATION* indicators. Figure 5-23 illustrates the internal component layout of the BSU Switch Assembly.

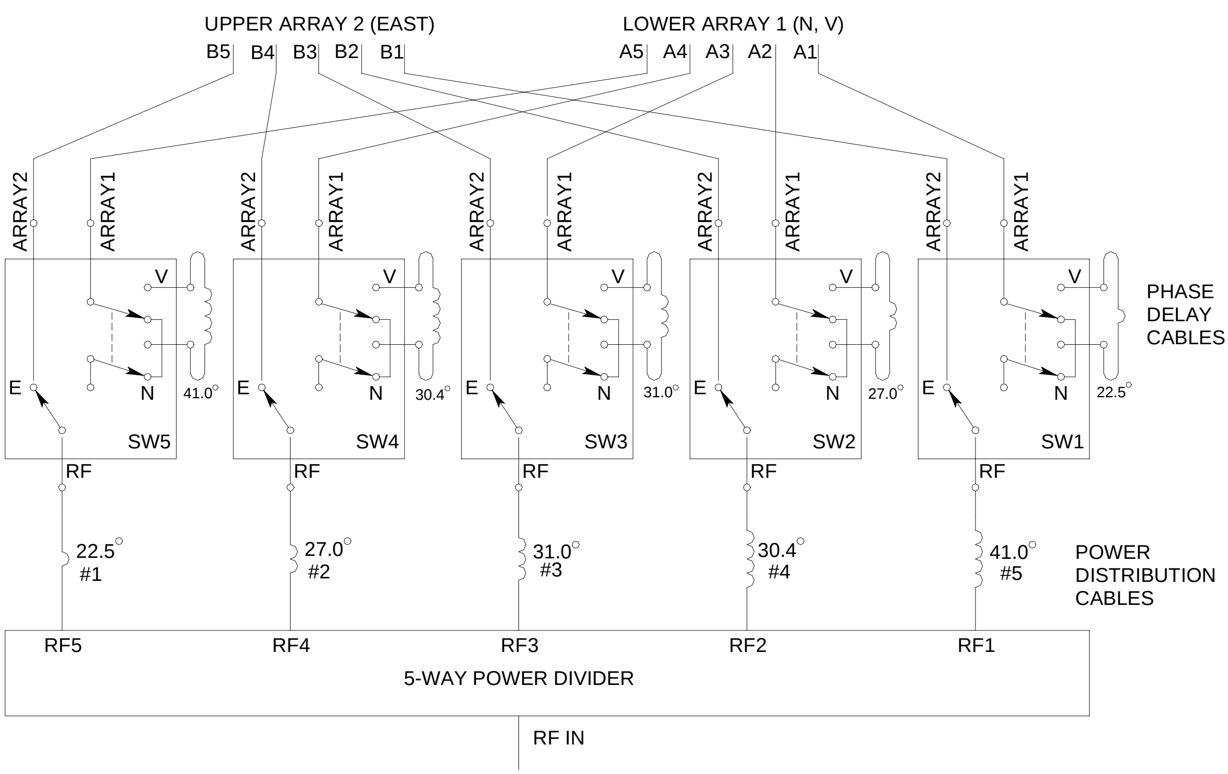


Figure 5-21 BSU Functional Block Diagram

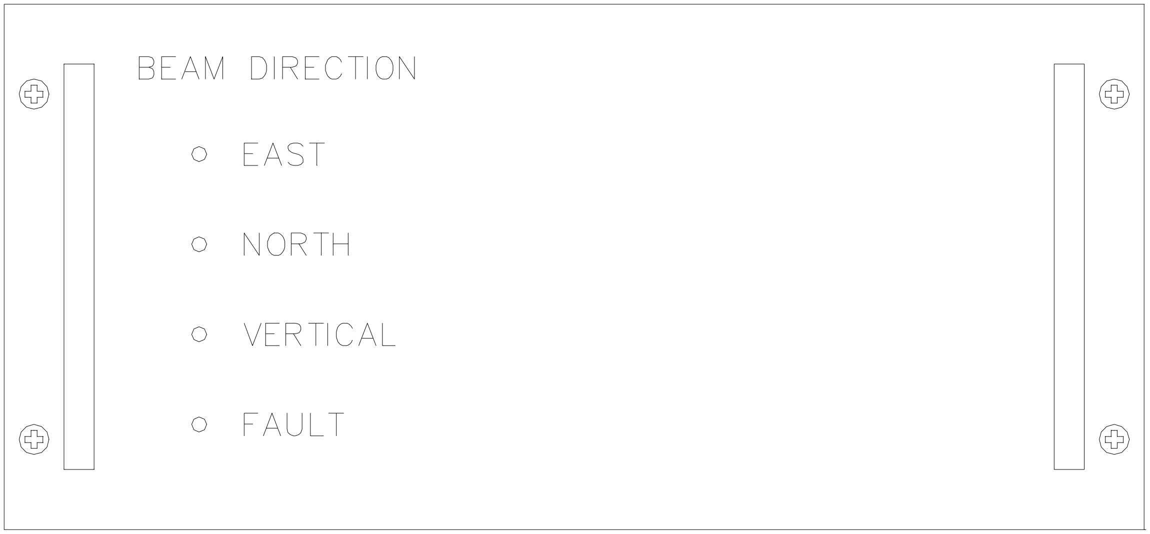


Figure 5-22 Type 2 BSU Switch Assembly Front Panel

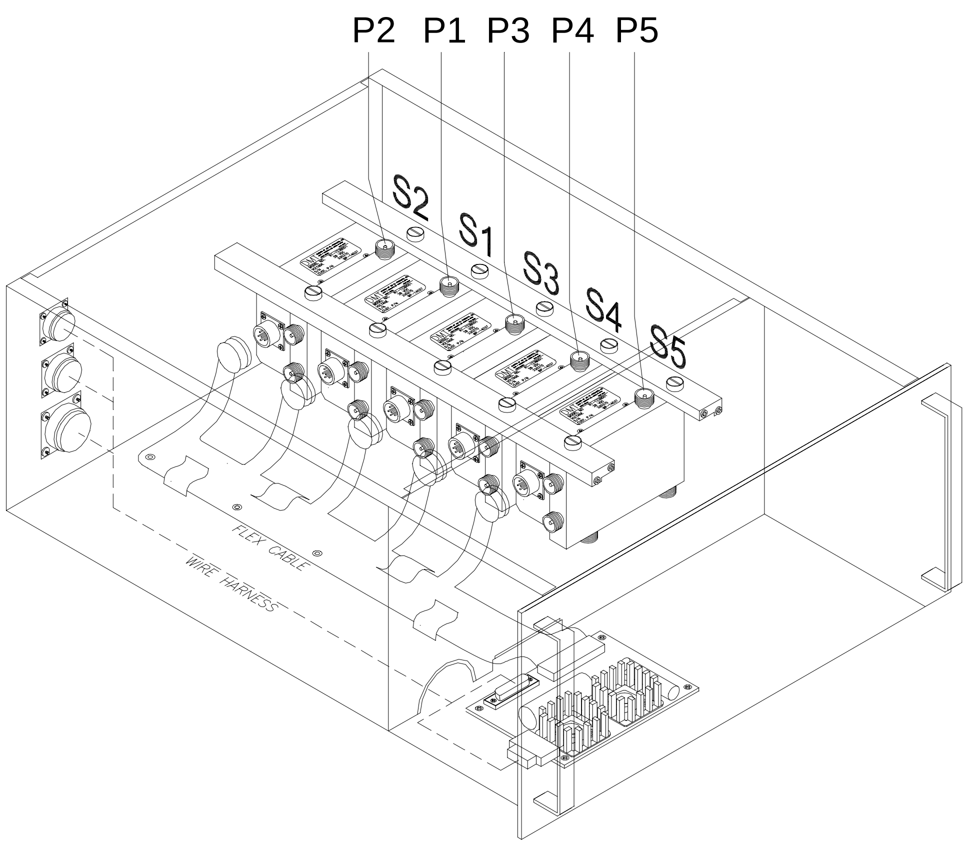


Figure 5-23 Type 2 BSU Switch Assembly Internal Component Layout

5.8.1 Coaxial Switch Assemblies

The BSU Switch Assembly contains five identical coaxial switches that control routing RF energy to the east and north/vertical antenna arrays (see Figure 5-24). Internally, the coaxial switch assembly is comprised of two sets of relays actuated by two +28 VDC solenoids. Solenoid operation is monitored using optical sensors that detect actuation failures. Figure 5-24 shows the physical configuration of a coaxial switch and its schematic diagram. Figure 5-25 depicts the route of RF energy through the switch in the various beam positions.

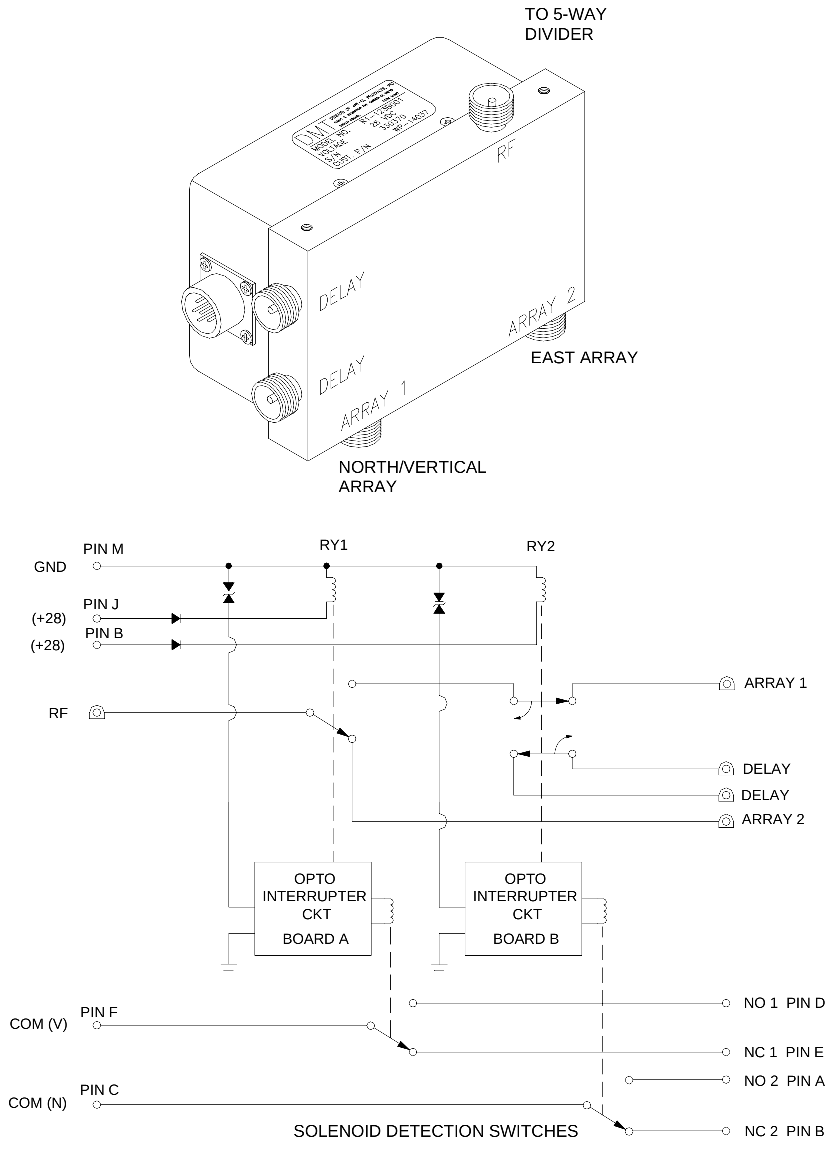


Figure 5-24 BSU Coaxial Switch Assembly Schematic Diagram

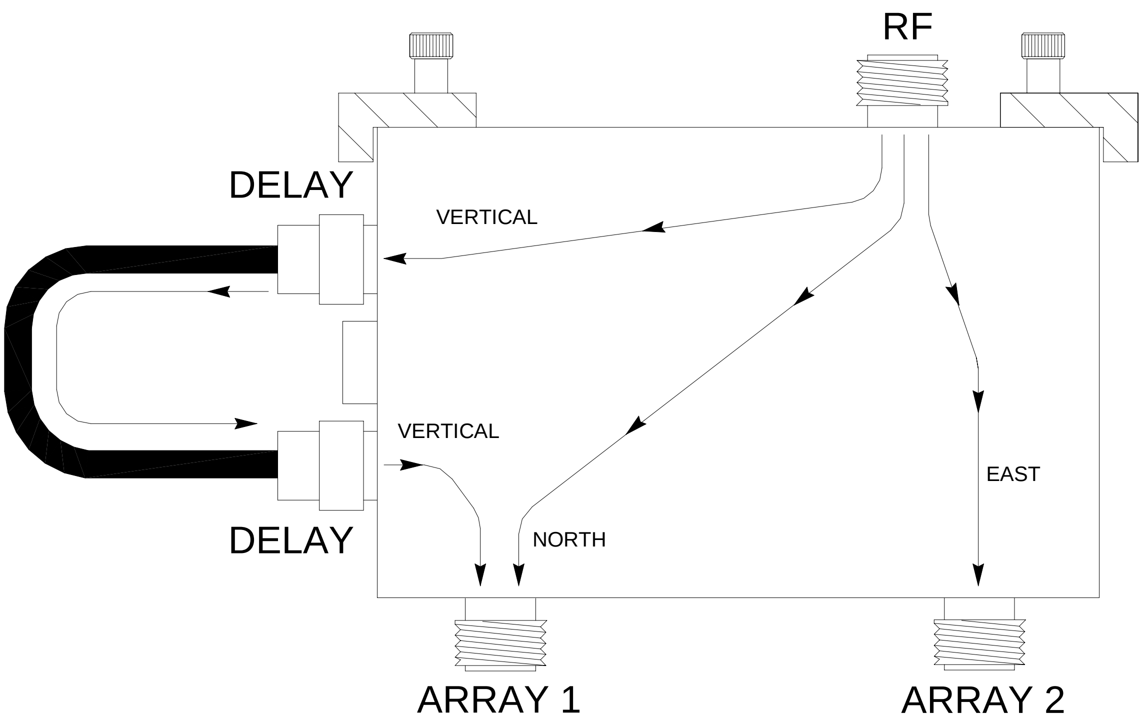


Figure 5-25 BSU Coaxial Switch Signal Routing

5.8.2 BSU Control Interface

The function of the BSU system is to accept a beam position (East, North, Vertical) command and select Array #1 or Array #2 and insert the phase delay cables in the RF path when necessary. The BSU contains monitoring circuits that compare the input command signals with actual switch positions. Error signals, if any, are sent to the Signal Processor/Controller which immediately shuts down the RF Frequency Generator and the System Status Monitor which records the fault. Front panel LEDs indicate beam position and BSU fault condition.

The beam position command is a two bit differential line signal originating from the Signal Processor (SP)/Controller. The logic interface decodes the input signal and drives the SPDT and DPDT bypass relays as listed in Table 5-1. Three green LEDs located on the front panel indicate current beam position. A red LED also located on the front panel illuminates when the switch positions do not match the input beam position command. Relay switching time is 30 milliseconds. During beam switching the input command and switch position do not match, resulting in illumination of the BSU fault light. This brief illumination is normal. RF is turned off for 50 milliseconds during switching intervals to eliminate stress on the relay contacts. Auxiliary contacts on every relay feed logic circuits that detect actual switch position and signal the SP/Controller to inhibit RF if any switch is not in the correct position. Additionally. if the fault persists for more than five seconds. the System Status Monitor turns the RF PA Quads off. places the system in the radar inoperative mode. and sets the BSU failure error message.

The BSU interface connectors provide supply voltages and control signals required by the BSU switches, control circuitry, and status monitoring circuitry. Table 5-2 provides the pinout and signal names for the BSU interface connectors J1, J2, and J3.

Table 5-1 BSU Control Signal Logic and Relay Response

Beam Direction	Control Signal B1	Control Signal B0	Relay Voltage SPST	Relay Voltage DPDT
Vertical	1	1	+28 VDC	+28 VDC
East	0	1	0 VDC	0 VDC
North	1	0	+28 VDC	0 VDC

Table 5-2 BSU I/O Connector Pin Assignments

Pin	**Signal**
Connector J1- 1	+5 VDC Input (A feed)
Connector J1- 2	--
Connector J1- 3	--
Connector J1- 4	--
Connector J1- 5	-5 VDC Input (to J3, PIN 2)
Connector J1- 6	--
Connector J1- 7	+5 VDC Return (A feed)
Connector J1- 8	-5 VDC Return (to J3, PIN 5)
Connector J1- 9	+60 VDC Input (to J3. PIN 3)
Connector J1- 10	+5 VDC Input (B feed)
Connector J1- 11	+28 VDC Input (A feed)
Connector J1- 12	+60 VDC Return (to J3. PIN 6)
Connector J1- 13	+28 VDC Input (B feed)
Connector J1- 14	+28 VDC Return (B feed)

Table 5-2 BSU I/O Connector Pin Assignments

Pin	Signal
Connector J1- 15	+5 VDC Return (B feed)
Connector J1- 16	+28 VDC Return (B feed)
Connector J2 - 1	T/R Pulse (True) (to J2 PIN 7)
Connector J2 - 2	T/R Pulse (Complement) (to J3 PIN 8)
Connector J2 - 3	Beam Position - 1 True
Connector J2 - 4	Beam Position - 1 Complement
Connector J2 - 5	Beam Position - 0 True
Connector J2 - 6	Beam Position - 0 Complement
Connector J2 - 7	--
Connector J2 - 8	--
Connector J2 - 9	--
Connector J2 - 10	--
Connector J2 - 11	SP-BSU-FLT-True (to Signal Processor)
Connector J2 - 12	SP-BSU-FLT-Complement
Connector J2 - 13	SM-BSU-FLT-True (to Status Monitor)
Connector J2 - 14	SM-BSU-FLT-Complement
Connector J2 - 15	--
Connector J2 - 16	--
Connector J 3 - 1 (to T/R Switch)	+5 VDC Output
Connector J 3 - 2	-5 VDC Output
Connector J 3 - 3	+60 VDC Output
Connector J 3 - 4	+5 VDC RTN
Connector J 3 - 5	--
Connector J 3 - 6	+60 VDC RTN
Connector J 3 - 7	T/R Pulse (True)
Connector J 3 - 8	T/R Pulse (Complement)

5.8.3 BSU Switch Fault Isolation

BSU switch failures manifest themselves as switch and driver faults and/or VSWR faults. Switch and driver faults are internal solenoid or relay failures (which can also cause a VSWR fault). VSWR (Voltage Standing Wave Radio) faults cause excessive amounts of reflected RF power. The following procedure can be used to test and isolate faulty BSU switch(es).

1. Remove the side panel from the BSU cabinet.

2. Turn off the Power Amplifier Cabinet at the breaker panel. (#17/19).

3. Disconnect the five power distribution cables from the *RF* input connector of each BSU switch assembly.

4. Disconnect the ten extension cables (W111) from the outputs (*ARRAY 1* and *ARRAY 2*) from each of the BSU switch assemblies.

5. Connect the PMT interface cable to the front of the Equipment cabinet, and login to the wind profiler system.

6. Select the *SYSTEMS OPERATIONS* menu, select *TEST MODE* from the menu options. Select *DOPPLER TEST* from the *TEST MODE* menu. This menu enables the selection of specific beams.

7. Turn on the Site Master and connect the "N" type cable to the back of unit. Insure the Anritsu is displaying "Return Loss" a the top of the display, and Marker 1 (M1) is displaying "0.00 at 404.37 MHz" at the bottom of the display. If display is not correct, press ***RECALL SETUP***, press ***1***, then press ***ENTER***. The display should return to the correct settings.

8. Using the PMT *DOPPLER TEST* menu, use the arrow keys to move the cursor to ***BEAM***, and press ***F5***, Select the number (1 through 6) for beam to be tested. (high or low mode does not matter), press ***F6*** to enter the selection. Press ***F7*** to start the doppler test. Insure the LED indicator in the front panel of the BSU switches to the desired beam.

9. Place a 50 ohm load (provided in Anritsu kit) on the desired output connector at bottom of switch #1. East (labeled *ARRAY 2* on switch) is closest output to you. North\Vertical (labeled *ARRAY 1* on switch) is furthest away (Figure 5-26).

10. Connect the Anritsu cable to the connector on top of the switch (labeled RF) and wait for the cursor to sweep across the Anritsu's display. Marker 1 (M1) will

display the return loss reading. The reading is a negative quantity, though it is displayed as positive (see Figure 5-27).

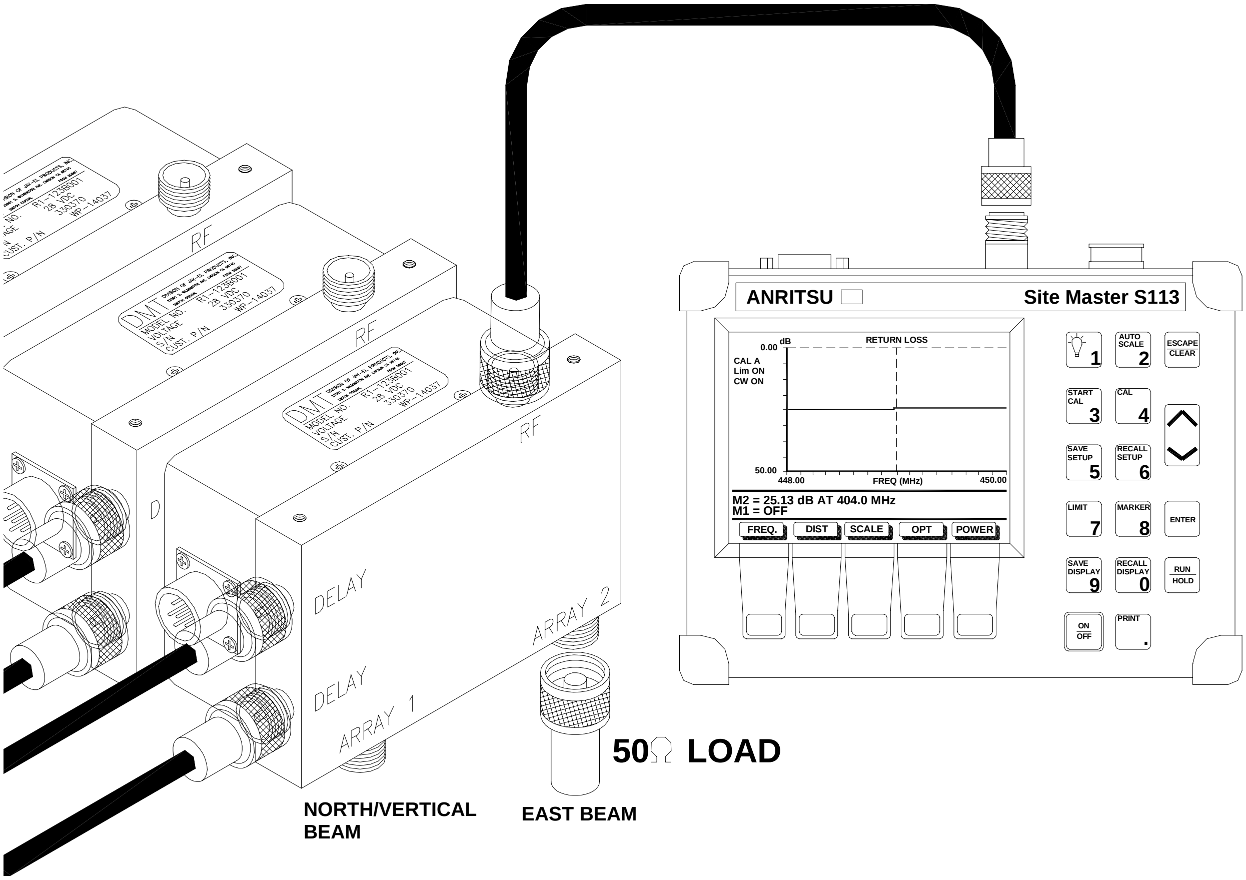


Figure 5-26 BSU Switch Return Loss Measurement

11. A good reading will be < 20db (more negative 21,22,23). A single digit display (typically 1 or less) will indicate a bad switch. See Figure 5-27.

12. Remove 50 ohm load and place on switch to be tested.

13. After all switches are tested in one beam. Press ***F1*** on the PMT to end the current doppler test. Repeat steps 8-11 until all switches are tested in all three beams

14. After testing all the BSU switches and performing any required switch replacement, test all ten antenna feed cables using the procedure defined in Section 7.4 to ensure there are no antenna related problems.

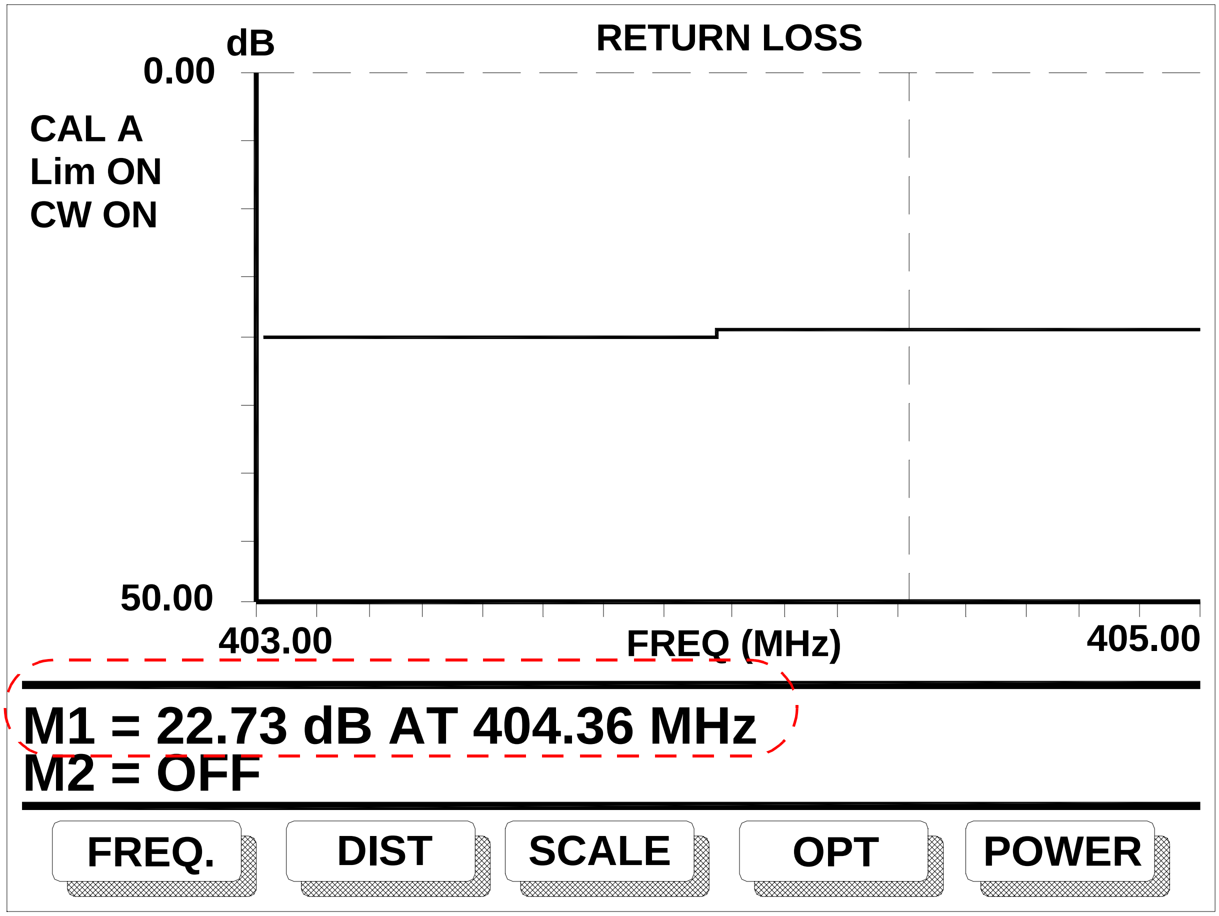


Figure 5-27 Anritsu Return Loss Display

5.8.4 Type 2 404 MHz BSU Switch Assembly Replacement Procedure

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the side panel of the BSU Cabinet and the blank panel above the BSU front panel.

3. Loosen the retaining nuts on connectors P1, P2, and P3 on the rear panel of the BSU Switch Assembly and remove the connectors from ports J1, J2, and J3 (see Figure 5-28).

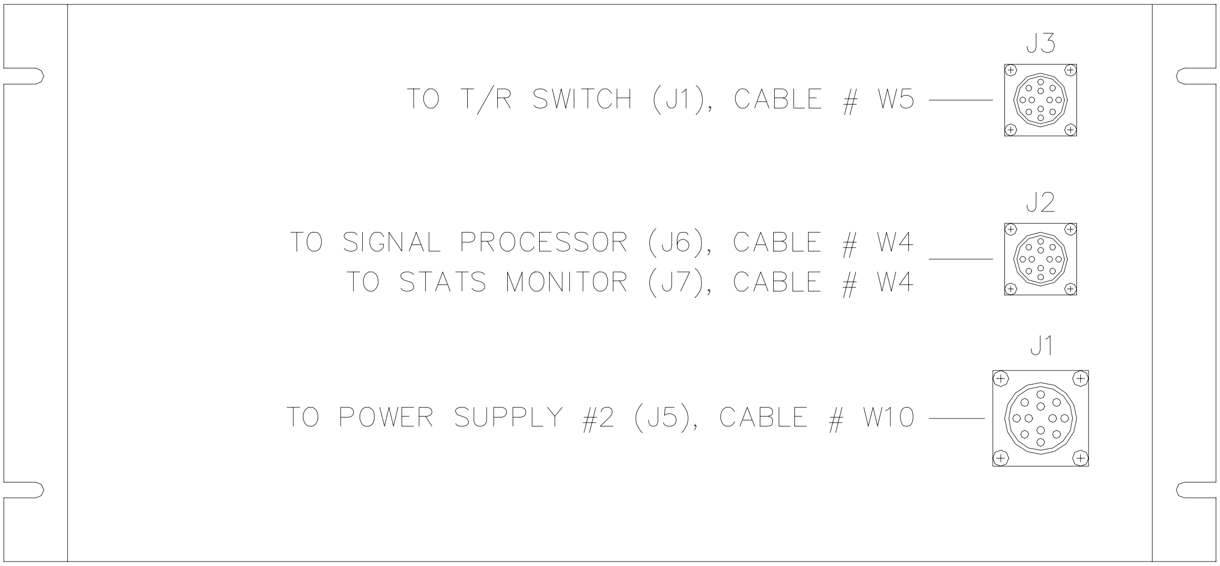


Figure 5-28   BSU Switch Assembly Rear Panel

4. Loosen and remove the type "N" connectors between the 10 Extension Cables and the BSU Switch Assembly [refer to Figure 5-24].

5. Note the location of the five Power Distribution Cables before they are disconnected from the BSU Switch Assembly. These cables must be reconnected in the same position after installing the new BSU Switch Assembly.

   Loosen and remove the type "N" connectors from the inputs of the BSU Switches [refer to Figure 5-24] and disconnect the five Power Distribution Cables.

6. Remove the four mounting screws on the front panel of the BSU and carefully lift the unit out the front of the BSU Cabinet.

7. Remove the top panel of the new BSU Switch Assembly to reveal the interface/ driver circuit board. Verify that the interface cable connectors are properly seated and fastened to the circuit board.

8. Install the new BSU Switch Assembly and replace the four mounting screws on the front panel of the cabinet.

9. Replace the ten Extension Cables [refer to Figure 5-24].

****NOTE****

Make sure all cables are connected to the proper BSU Switch. Avoid cross threading when tightening the type "N" connectors. All connections should be as tight as possible since loose connections will cause a VSWR fault.

10. Reconnect the five Power Distribution Cables to the BSU Switches as shown in Figure 5-23.

11. Replace connectors P1, P2, and P3 on the rear panel of the BSU Switch Assembly and tighten the retaining nuts.

12. Replace the blank panel above the BSU front panel.

13. Perform the Circulator port 3 power level test procedure described in Section 5.4.2 to verify the new BSU is not causing excessive reflected power.

14. Replace the side panel of the BSU Cabinet.

15. Follow the standard power-up sequence described in Section 2.4.

6 Power Amplifier Cabinet

The location of the Power Amplifier (PA) Cabinet in the wind profiler Shelter Assembly is identified in Figure 2-3 and Figure 2-6. Front and internal views of the Power Amplifier Cabinet are presented in Figure 6-1 and Figure 6-2.

The PA Cabinet contains the following transmitter-related Line Replaceable Units (LRUs): the Amp Local Status Monitor, sixteen Power Amplifier Modules, twelve 5" 12 VDC cooling fans, one 9" 220 VAC cooling fan, the Power Amplifier Combiner, the RF Driver, and four Power Amplifier Power Supplies. The Power Amplifier Block Diagram is shown in Figure 6-3.

The Power Amplifier is capable of delivering 16 KW of peak power at a maximum duty cycle of 15%. However, it has been determined adjusting the Power Amplifier output to 6 KW (peak) is desirable. Lowering the total output power has minimal impact on height coverage and has shown an increase in the MTBF (mean time between failures) of transmitter and BSU components. The Power Amplifier is designed to withstand PA module, driver, and power supply failures and still operate in a degraded condition. Front panel indicators provide LRU status information and fault localization.

6.1 Power Amplifier Local Status Monitor

The Power Amplifier Local Status Monitor (AMP Local Monitor) oversees all transmitter components (see Figure 6-1 and Figure 6-2). The AMP Local Monitor operates in two modes, local and remote. In the remote mode, transmitter status information is communicated to the System Status Monitor (SSM) via an RS-232 interface. In the local mode, field maintenance personnel can utilize the front panel controls of the AMP Local Monitor to evaluate the performance of the transmitter and use it as a diagnostic tool.

The AMP Local Monitor is normally in remote mode. When you switch to local mode, the unit will automatically return to remote mode if user interaction does not occur within 15 minutes. When the AMP Local Monitor is in local mode, the interface between it and the System Status Monitor is disabled. As a consequence, PA Module reset commands (generated by the SSM) cannot reach the local monitor, and manual resets must be performed after each beam switch to ensure that all PA modules are available when the radar enters high mode.

The following list identifies the various AMP Local Monitor controls and displays (see Figure 6-4 for location of each item). The number in square brackets ([#]) corresponds with the identification number in Figure 6-4. The text to the right of the number identifies the label and physical description of each item, and the text below it describes the function or special attributes of the item.

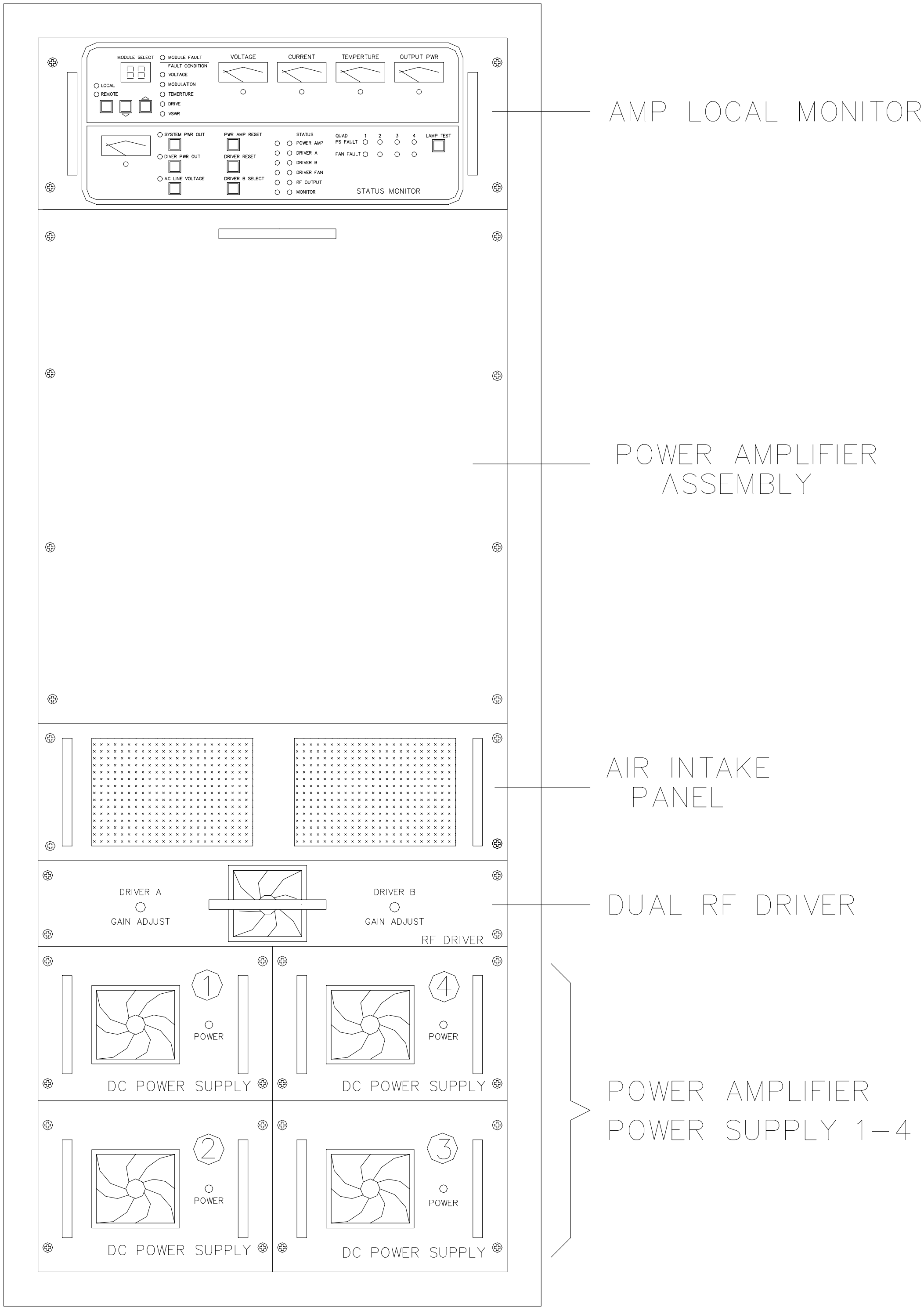


Figure 6-1 Power Amplifier Front Panel Layout

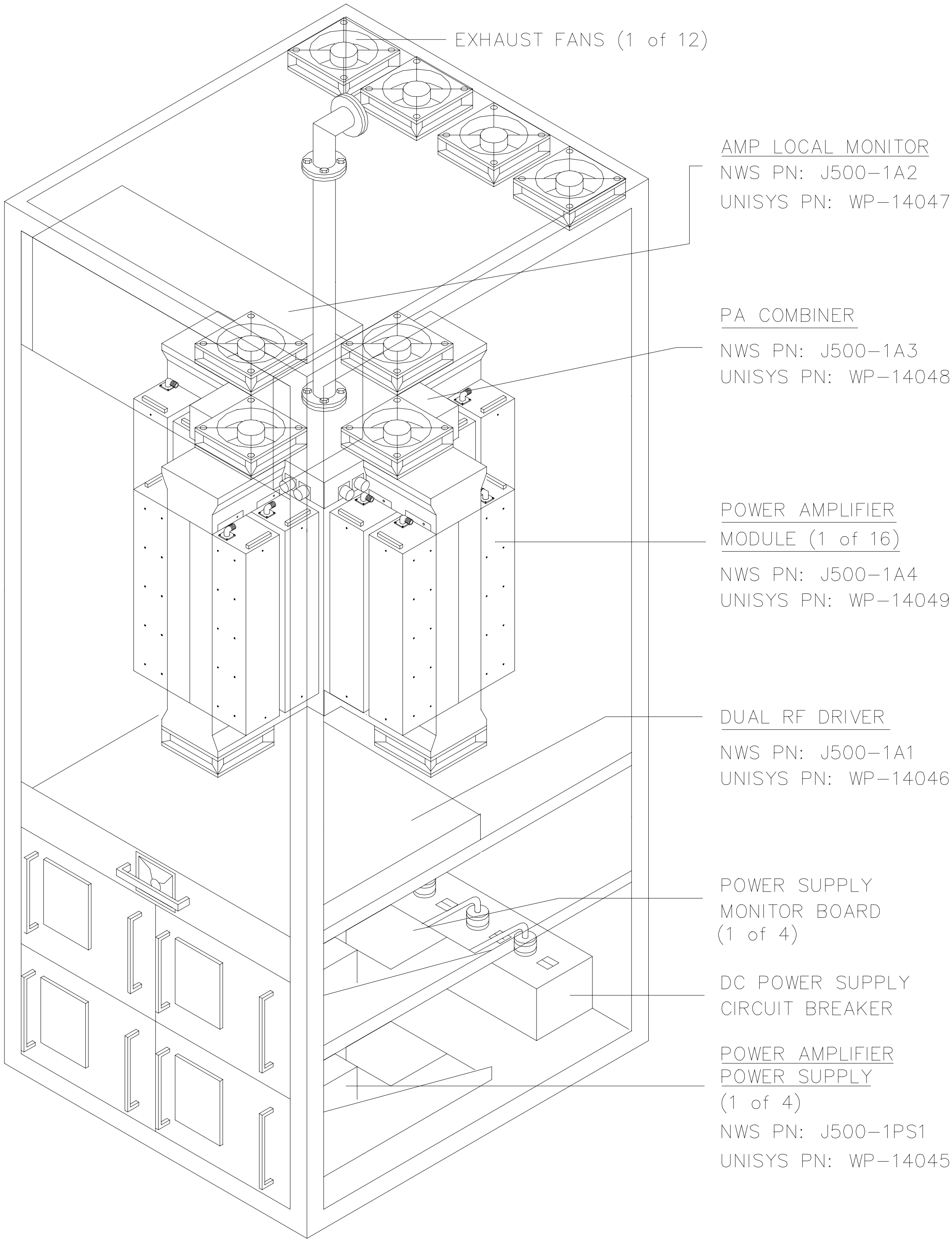


Figure 6-2 Power Amplifier Internal Component Layout

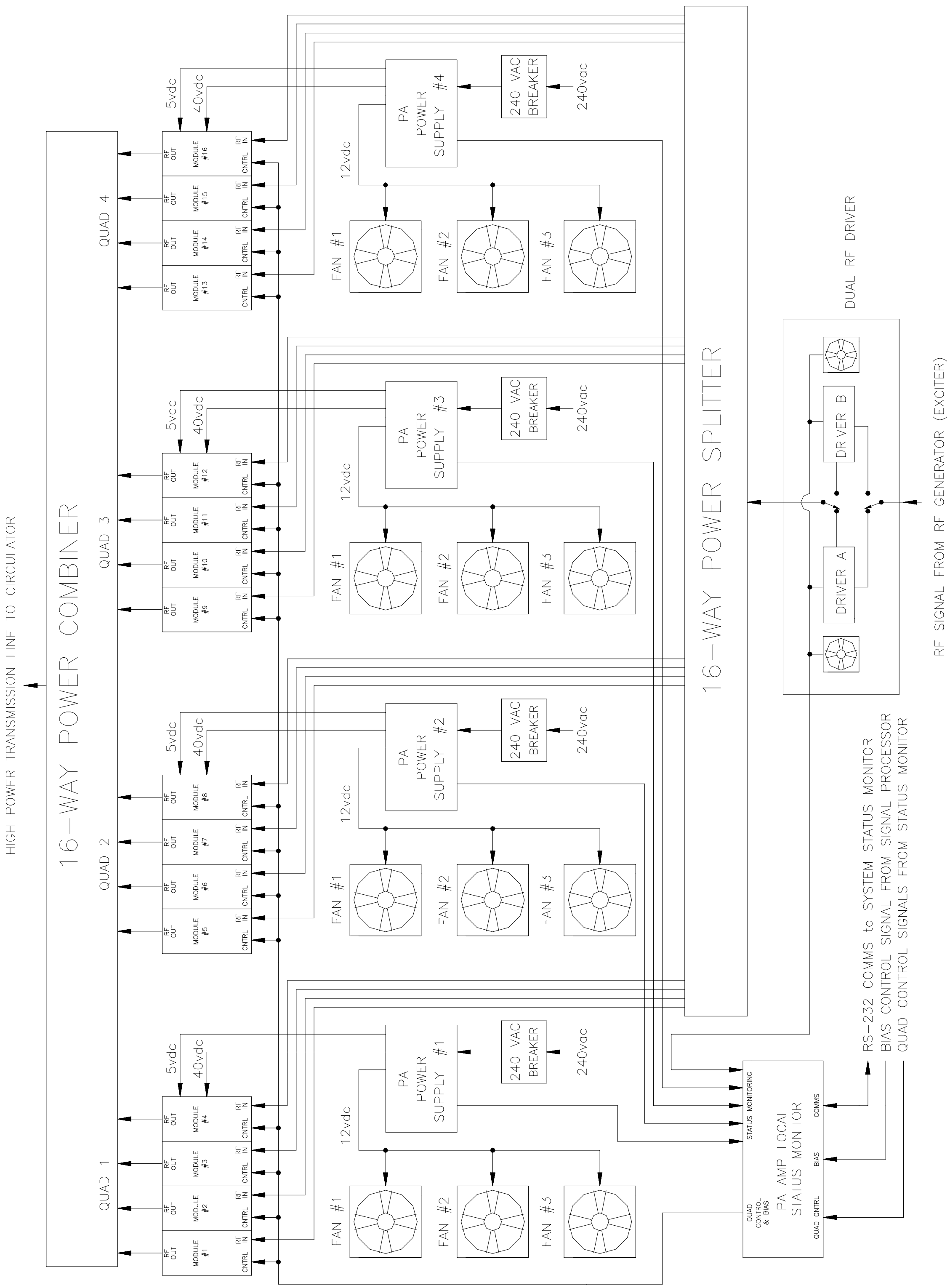


Figure 6-3 Power Amplifier Block Diagram

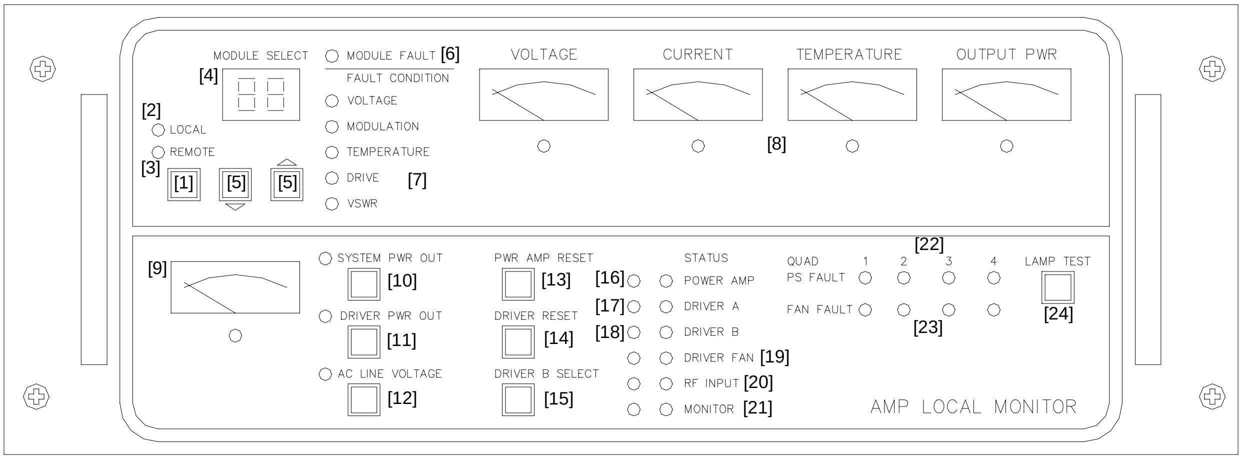


Figure 6-4 Amp Local Monitor Front Panel

[1] **LOCAL/REMOTE BUTTON**

Toggles the unit between local and remote modes.

[2] **LOCAL (INDICATOR LED)**

Indicates unit is in local mode.

[3] **REMOTE (INDICATOR LED)**

Indicates unit is in remote or normal operating mode.

[4] **MODULE SELECT (DISPLAY)** - Functions in local mode only.

Displays the PA module number as selected by increment/decrement buttons. The range is from 1 to 16.

[5] **INCREMENT/DECREMENT (BUTTONS)** - Functions in local mode only.

Selects which power amp. module parameters will be displayed on the upper indicators located on the front panel.

[6] **MODULE FAULT (LED)** - Functions in local mode only.

Illuminates if a fault exists in a selected module.

[7] **FAULT CONDITION (LEDs)** - Functions in local mode only.
Illuminates to indicate which parameters have failed on a selected module. Parameters include voltage, modulation, temperature, driver, and VSWR.

[8] **UPPER PANEL METERS** - Functions in local mode only.
Displays approximate levels of voltage, current, temperature, and output power for a selected module.

[9] **LOWER PANEL METER** - Functions in remote or local mode.
Displays the level of system power output, driver power output, or AC line Voltage as selected by buttons [10], [11], and [12] respectively.

[10] **SYSTEM PWR OUT (BUTTON)** - Functions in remote or local modes.
Sets the analog panel meter to display the approximate level of the system power output. The corresponding LED will illuminate when selected.

[11] **DRIVER PWR OUT (BUTTON)** - Functions in remote or local mode.
Sets Lower Panel Meter to display the level of the driver power output. Corresponding LED will light when selected.

[12] **AC LINE VOLTAGE (BUTTON)** - Functions in remote or local modes.
Sets Lower Panel Meter to display the level of the AC line voltage. Corresponding LED will light when selected.

[13] **PWR AMP RESET (BUTTON)** - Functions in local mode only.
Will reset the power amplifier when pressed.

[14] **DRIVER A RESET (BUTTON)** - Functions in local mode only.
Will reset the driver module to driver "A" when pressed. Driver "A" cannot be reset while the transmitter is on. This function can be performed only when the Profiler is in maintenance mode via the Profiler Maintenance Terminal (PMT) or when the RF input is disabled.

[15] **DRIVER B SELECT (BUTTON)** - Functions in local mode only.
It sets the driver module to driver "B" when pressed.

[16] **POWER AMP (STATUS LEDs)** - Functions in remote or local mode.

Indicates the condition of the power amplifier modules, green = normal, red = fault. Note that even if all PA modules are functioning correctly, the fault LED will illuminate in low mode. This occurs because the four modules in quad four are disabled in low mode.

[17] **DRIVER A (STATUS LEDs)** - Functions in remote or local mode.

A green light indicates driver A is currently being used, a red light indicates a possible fault.

[18] **DRIVER B (STATUS LEDs)** - Functions in remote or local mode.

A green light indicates driver B is currently being used, a red light indicates a possible fault. If driver A is green, proper operation for B is for neither LED to be illuminated.

[19] **DRIVER FAN (STATUS LEDs)** - Functions in remote or local mode.

If light is illuminated, it indicates that either one or both of the two fans located inside of the RF Driver has failed.

[20] **RF INPUT (STATUS LEDs)** - Functions in remote or local mode.

Indicates the status of the RF input to the RF Driver from the RF Generator. A green light indicates that the correct RF level is detected at the input of the RF driver drawer. It is normal for the red indicator to be on when the profiler is in maintenance or test mode, during a SARSAT turn-off period, or during normal operation while the profiler is switching modes.

[21] **MONITOR (STATUS LEDs)** - Functions in remote or local mode.

A red light indicates faulty communications with the System Status Monitor. In most cases, the LRU associated with this fault is the serial interface module (SIM) located inside of the AMP Local Monitor. A green light indicates normal operation.

[22] **PS FAULT (LEDs)** - Functions in remote or local mode.

Indicates a PA power supply has failed when illuminated.

[23] **FAN FAULT (LEDs)** - Functions in remote or local mode.

Indicates at least one of the three PA cooling fans has failed in one of the four quad modules.

[24] **LAMP TEST (BUTTON)** - Functions in local mode only.

When pressed, all LEDs on the front panel of the AMP Local Monitor should illuminate.

6.1.1 AMP Local Monitor Replacement Procedure

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the left side panel (as seen from the front) of the PA Cabinet.

3. Disconnect the seven cables from the rear panel of the AMP Local Monitor (see Figure 6-5), and note the locations and polarity of their connectors for future reference.

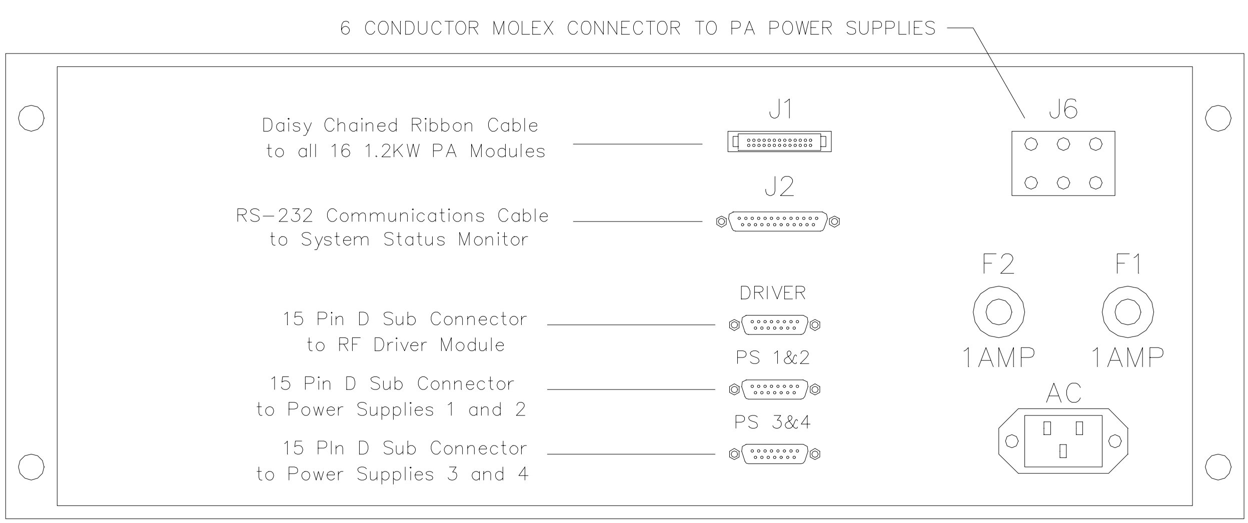


Figure 6-5 Amp Local Monitor Rear Panel

4. Remove the four mounting screws from the front panel of the AMP Local Monitor and remove the unit from the PA Cabinet.

5. Install the new AMP Local Monitor in the PA Cabinet and replace the four mounting screws on the front panel of the unit.

6. Reconnect the seven cables on the rear panel and tighten the fastening screws.

7. Replace the left side panel of the PA Cabinet.

8. Follow the standard power-on sequence described in Section 2.4.

6.1.2 AC Line Voltage Monitor

When the shelter AC line voltage rises or falls outside certain limits (+/- 10% of 220 VAC), the profiler generates BAD AC Line Voltage messages. These messages are written to the Failure Data Log every six minutes until the AC line voltage returns to normal.

The AMP Local Monitor measures the AC line voltage level using a circuit that steps down the AC voltage and rectifies it to a proportional DC voltage level. Occasionally, the circuit that monitors the AC line voltage drifts and requires calibration.

6.1.3 AC Line Voltage Monitor Calibration Procedure

The AC line voltage monitor circuit is calibrated by comparing a measured AC line voltage reading (using a DVM) against the Current AC Line Voltage value reported in the PMT Status Data block. If the two readings differ by more than + 5 VAC, AMP Local Monitor's AC line voltage circuit should be adjusted to match the voltage reading taken using the DVM.

AC Line Voltage Measurement and Comparison

1. Unplug one of the ECUs (air conditioner) power cord. Turn the switch on the control box to by-pass mode. Measure the 220 VAC voltage at the control box receptacle.

2. Log in to the system with the PMT. Select *Display Current Output* from the Main Menu. Select *Landline Data* from the *Display Current Output* menu. Select *Status Data* from the *Landline Output* Selections Menu. Locate the *Current AC Line Voltage* field on the PMT screen, and compare the value to the reading on the DVM (see Figure 6-6). If the readings differ by more than ~5 VAC, take another sample reading using the following steps.

3. Press F1 on the PMT to back-out of the *Status Data* screen, to the previous menu.

4. Wait until the radar cycles to the East Beam (about six minutes) and select Status Data again.

5. If the PMT reading differs +/- 5 volts from the measured reading, the AMP Local Monitor AC line voltage circuit should be calibrated.

```
2 Waiting for system mode response from WPS       Operational
3 Waiting for system mode response from WPS
4 WPS-234, PASSWORD REQUIRED
                            System Status Data Block

 Mode: 03  Submode: 01                Length: 0035   Checksum: 24D8

 PA Foward Power:10.00 System Noise:   65
 Antenna Power - Forward:  77  Reflected : 004
 Miscellaneous Status: 00000000
 LRU Byte 1:1010101   Byte 2: 00000000 Byte 3:0000111   Byte 4:00000000
 Failed PA mod: 0 Driver: 0 Failed PS: 0 Failed Quad fans: 0 Dr. fan UP
 Transmitted Power:37.50 AC Line Voltage - Low: 228  High:  246
 Driver Output Power: 119  Current AC Line Voltage: 236
 Shelter Status Byte 1: 00000000  Byte 2: 00000000
 Temperature (Deg. C):- Inside:20.83 Outside  17.08
 Status of - Exciter: 00000000 Power Supplies: 00000000  Antenna: 00000000
 Online Test Status: 00000000
 Goes Error Codes - Byte 1: 00000000  Byte 2: 00000000
 Message Status - Good Msgs: 00
 Messages with Comm Errors: 00 Msgs with Content Errors: 00
 Last Failure Date:
 Error Code: 00 Amplification Count: 00
                                                                      Prev    Next
1 Prev  2       3       4       5        6       7     8     9Screen 0Screen
```

Figure 6-6 PMT System Status Data Block Display

Calibration Procedure

1. Remove the top-front panel from the Transmitter Cabinet.

2. Remove the top panel from the AMP Local Monitor.

3. Locate potentiometer R11 on the vertically mounted circuit board mounted on the chassis rear panel (see Figure 6-7).

4. To increase the reading displayed on the PMT, rotate pot R11 clockwise. To decrease the reading displayed on the PMT, rotate pot R11 counter-clockwise (see Figure 6-7).

5. Make a small change to pot R11. Wait six minutes (or until the profiler cycles to the East Beam). Back-out of the *Status Data* screen on the PMT by pressing F1. Select *Status Data* and check the *Current AC Line Voltage* reading on the PMT.

6. Repeat step 5 until the reading on the PMT is within +/- 3 volts of the actual AC line voltage.

7. Replace the top panel on the AMP Local Monitor. Replace the top panel on the Transmitter Cabinet.

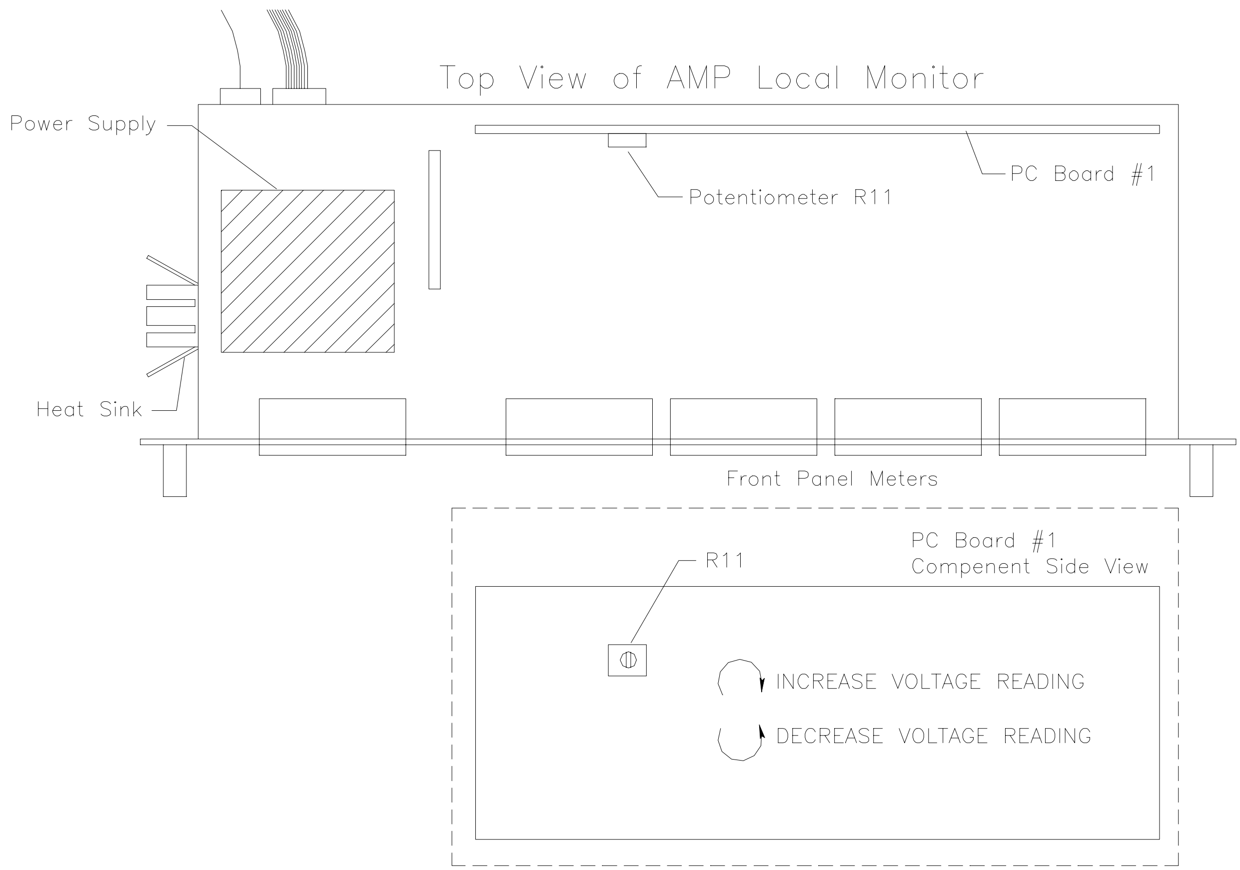


Figure 6-7 Amp Local Monitor AC Line Voltage Calibration

6.2 Dual RF Driver

The Dual RF Driver is located in the PA Cabinet below the air intake panel and the 16 Power Amplifier Modules (see Figure 6-1 and Figure 6-2). This component provides 80 watts (40 dB) of RF drive power to the PA Amplifier Modules in the transmitter.

The Dual RF Driver consists of two identical drivers identified as A and B. Driver A is the primary driver and is normally active. If it fails, the back-up, driver B, becomes active. Failure of Driver B will not result in an automatic switch-over to Driver A. If the radar is using Driver B and Driver B fails, the radar is rendered inoperative.

6.2.1 RF Driver Replacement Procedures

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the right side panel (as seen from the front) of the PA Cabinet.

3. Rotate the two handles on the power supply sub-panel and remove the panel from the lower half of the PA cabinet.

4. Note the cable connections for future reference (see Figure 6-8). Disconnect the five cables from the rear panel of the Dual RF Driver.

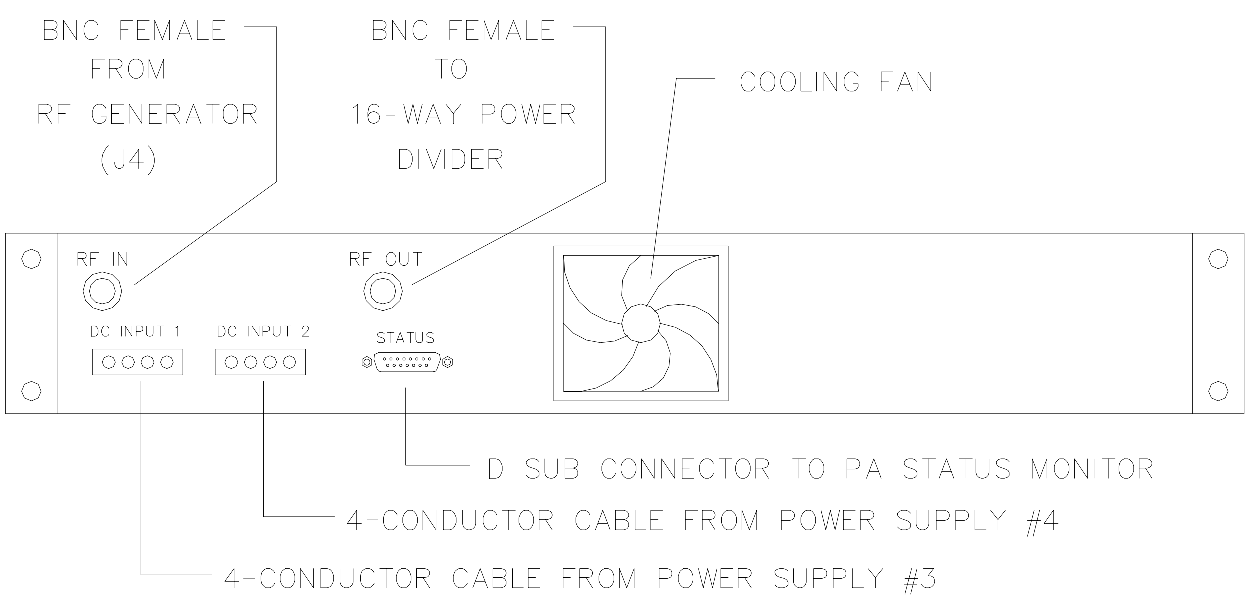


Figure 6-8 Dual RF Driver Rear Panel

5. Remove the four mounting screws from the front panel of the RF Driver and slide the unit out the front of the PA cabinet.

6. Install the new Dual RF Driver and replace the four mounting screws on the front panel of the unit.

7. Reconnect the five cables on the rear panel of the RF Driver.

8. Replace the power supply sub-panel and secure by rotating the handles until the latches engage.

9. Replace the right side panel of the PA Cabinet.

6.2.2 RF Driver Calibration Procedures

The gains of the 16 PA Modules are fixed, therefore, the output power of the Driver determines the total output power of the transmitter. When the Dual RF Driver is replaced, the drive levels of Drivers A and B must be set. [The RF Driver output levels are calibrated by measuring the transmitter output power at the forward power port of the Directional Coupler using a peak power meter, and adjusting the output of each driver to achieve the desired output power level.]

- HP8491A 10 dB Attenuator
- HP84811A Power Sensor
- HP8900D Peak Power Meter
- Digital Volt Meter (DVM)
- 100 MHZ Oscilloscope
- 2 - BNC (M) to BNC (M) coaxial cables
- Small flat-blade screwdriver
- Flashlight

Test Equipment Setup

1. Remove the side panel from the BSU Cabinet. Disconnect the 3-dB pad and cable from the forward power port of the Directional Coupler [point (A) in Figure 6-9].

2. Connect one end of the HP8491A 10-dB Attenuator to the HP84811A Power Sensor and the other end to the FWR (forward) power port of the Directional Coupler as illustrated in Figure 6-9.

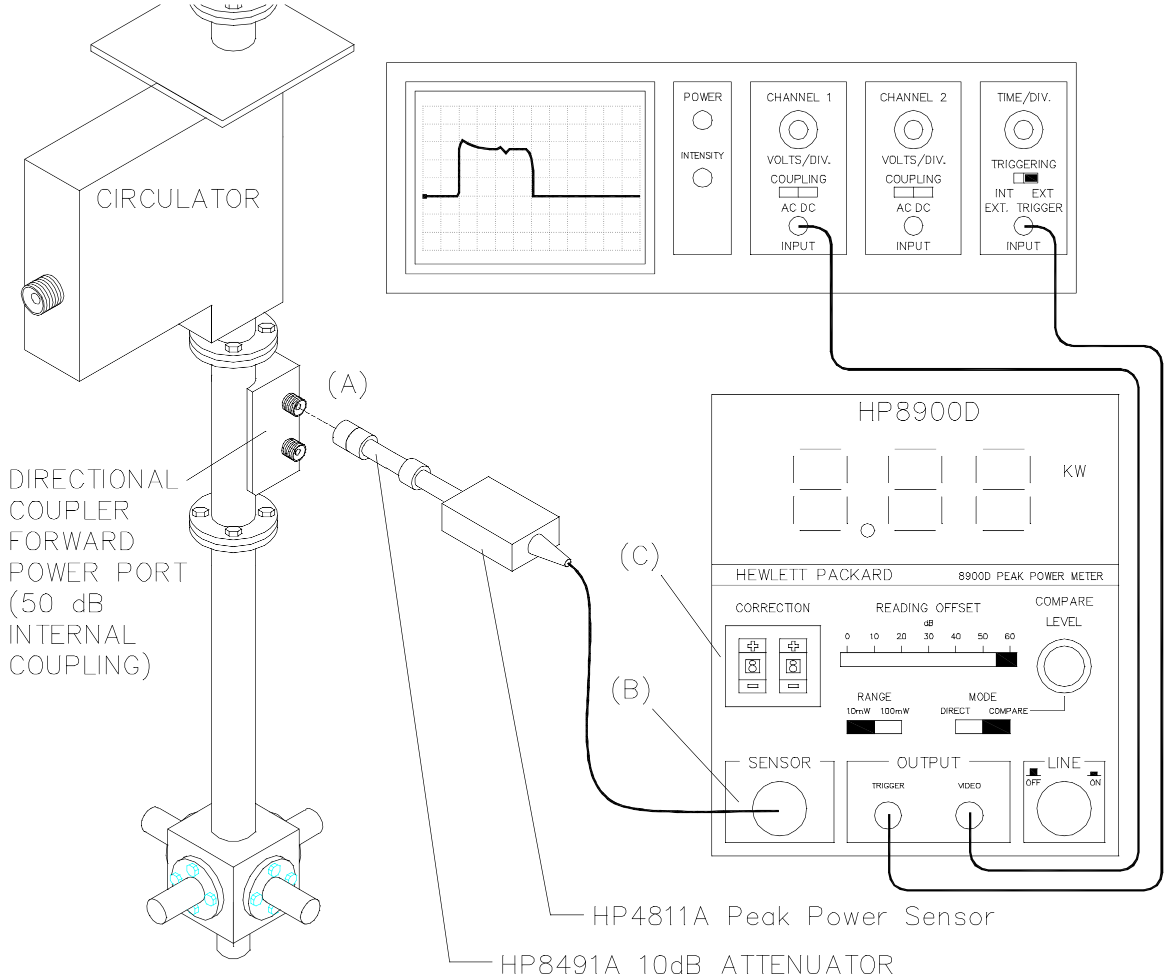


Figure 6-9 Forward Power Sensor Calibration Test Equipment Setup

3. Connect the output cable of the Power Sensor to the SENSOR input of the HP8900D Peak Power Meter (point B in Figure 6-9).

4. Determine the correction factor marked on the HP84811A Power Sensor that is nearest to the 400-MHz range and dial it into the CORRECTION switches on the front panel of the HP8900D Peak Power Meter (point C in Figure 6-9).

5. Set the READING OFFSET on the HP8900D Peak Power Meter to "60 dB", set the MODE to "COMPARE", and the RANGE to "10 mW". If an over range condition occurs during measurements, change the range to "100 mW".

6. Connect the Trigger Output of the HP8900D to the External Trigger Input of an oscilloscope using a BNC (M) to BNC (M) coaxial cable.

7. Connect the Video Output of the HP8900D to Channel One of the Oscilloscope using a BNC (M) to BNC (M) coaxial cable.

8. Oscilloscope Settings:

Channel One Volts/Div:	5 mV/Div
Time/Div:	5 s/Div
Trigger:	External
Trigger Edge:	Rising Edge

Power Measurement

The profiler spends two minutes in each of its three beams (east, north, and vertical): one minute in the high mode and then one minute in the low mode. All power measurements and adjustments must be made in the same beam and mode to ensure the consistency of the measurements.

Observe the front panel of the Beam Steering Unit to determine when the profiler is in a particular beam and mode. When the radar switches beams, one minute remains to make measurements or adjustments in high mode before it switches to low mode using the procedures described below. If measurements or adjustments cannot be made in the selected one minute period, wait until the next time the radar switches into the desired beam and mode.

While the radar is in the beam and mode that has the highest measurable power, observe the waveforms on the oscilloscope. Adjust the *COMPARE LEVEL* knob on the HP8900D to position the *Compare Trace* at the top of the transmitted pulse waveform, averaging through any ripples. Figure 6-10 and Figure 6-11 are examples of transmitted pulses in the high and low modes respectively, the compare traces in these figures have been positioned correctly. Record the peak power value displayed on the HP8900D (referenced below as $P_{measured}$).

Power Measurement and Adjustment

1. Follow the standard power-up sequence described in Section 2.4.

2. Use the AMP Local Monitor to verify that Driver A is selected. If Driver A is not selected, put the AMP Local Monitor in *LOCAL* mode and press the *DRIVER RESET* button on the front panel of the monitor. If the driver will not reset, choose one of the following:

Figure 6-10 20 us Peak Power Pulse in High Mode

Waveform displayed on an oscilloscope when used in conjunction with an HP8900D peak power meter. The vertical position of the **Compare Trace** is varied by rotating the *Compare* knob on the HP8900D.

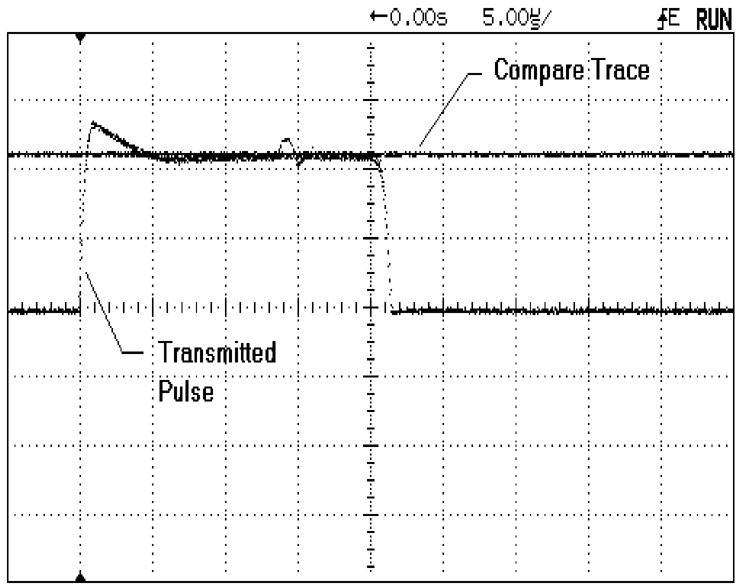
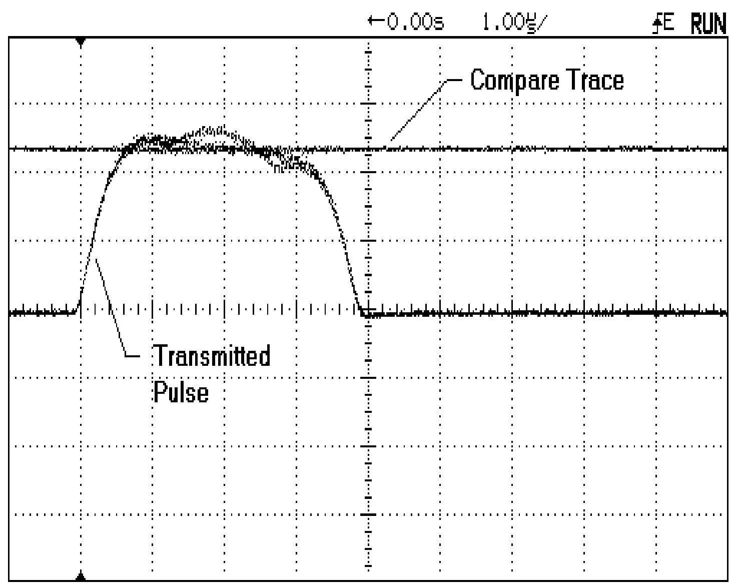


Figure 6-11 3.33 us Peak Power Pulse in Low Mode

Waveform displayed on an oscilloscope when used in conjunction with an HP8900D peak power meter. The vertical position of the **Compare Trace** is varied by rotating the *Compare* knob on the HP8900D.



Use the PMT to put the profiler into maintenance mode and reset the Driver. After this has been accomplished, use the PMT to put the profiler back into operational mode. Or;

Disconnect the coaxial cable on back of the PA Cabinet to disable the output of the RF Generator. Reset the Driver and reconnect the coaxial cable.

3. Put the AMP Local Monitor in LOCAL mode.

4. Use the *UP-ARROW/DOWN-ARROW* (Increment/Decrement) buttons on the front panel of the AMP Local Monitor to step through all 16 PA modules. Record the number of PA Modules that do not output power when the radar is in HIGH MODE by observing the OUTPUT PWR meter on the front panel of the monitor. If the radar switches beams while performing this procedure, press the *PWR AMP RESET* button on the front panel.

   The profiler spends two minutes in each of its three beams (East, North, and Vertical) one minute in the high mode and one minute in the low mode. All power measurements and adjustments must be made in the East High Mode to ensure the consistency of the measurements and adjustments.

5. Use Table 6-1 to determine the reduced transmitter power caused by PA modules with no output power meter deflection.

6. Put the AMP Local Monitor in *REMOTE* mode.

7. Observe the front panel of the Beam Steering Unit to determine when the profiler is in the East High mode. When the radar switches beams, you have one minute to make measurements or adjustments in the high mode before the radar switches to low mode. If measurements or adjustments cannot be made in the selected 1-minute period, wait until the next time the radar switches into the East High mode.

   With the radar in operational mode and transmitting in the East High beam, observe the meter reading on the Average Power Meter.

8. Use a thin, long-shanked screw driver to turn the Driver A Gain Adjustment on the front panel of the RF Driver (see Figure 6-12) and adjust the Power Meter reading to the value specified in Table 6-1.

   Note that the Driver Gain Adjustment trim pots are recessed 2.5 in. behind the front panel of the RF Driver. Take care not to short out any circuit inside the driver when performing the adjustment.

9. Press the *LOCAL* button on the front panel of the AMP Local Monitor and then press the *DRIVER B SELECT* button to enable the Driver B. When the profiler is transmitting in the East High mode, adjust the Driver B Gain Adjustment on the

front panel of the RF Driver to achieve the desired meter reading specified in Table 6-1.

10. Follow the standard power-down sequence described in Section 2.3.

Table 6-1 Failed PA Modules Versus Transmitter Output Power

Number of Working PA Modules	Average Power Measured at Forward Power Port of Directional Coupler during High Mode	Peak Power Measured at Forward Power Port of Directional Coupler during High Mode
1	3.1 W	23.4 W
2	12.4 W	93.8 W
3	27.8 W	210.9 W
4	49.5 W	375.0 W
5	77.3 W	585.9 W
6	111.4 W	843.8 W
7	151.6 W	1.148 KW
8	198.0 W	1.500 KW
9	250.6 W	1.898 KW
10	309.4 W	2.344 KW
11	374.3 W	2.836 KW
12	445.5 W	3.375 KW
13	522.8 W	3.961 KW
14	606.4 W	4.594 KW
15	696.1 W	5.273 KW
16	792.0 W	6.000 KW

11. Remove the test equipment from the forward power port of the Directional Coupler, and reconnect the 3-dB pad and cable.

12. Replace the side panel on the BSU Cabinet.

13. Follow the standard power-up sequence described in Section 2.4.

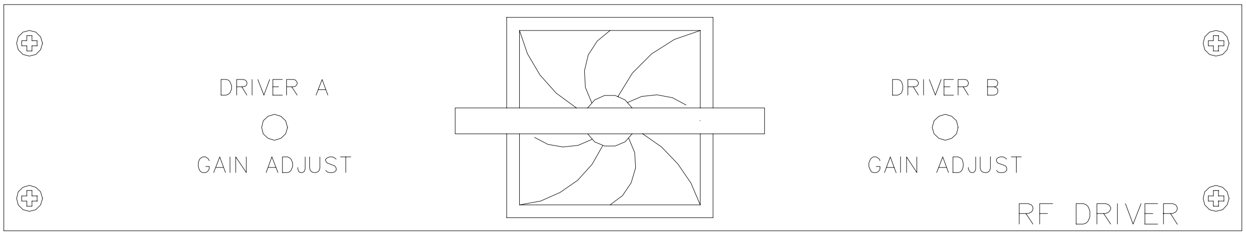
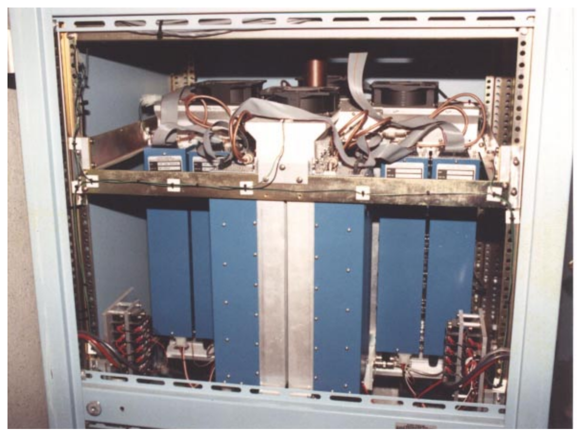


Figure 6-12 Dual RF Driver Front Panel

6.3 Power Amplifier Assembly

The Power Amplifier (PA) Assembly consist of a Power Divider, sixteen 1.2-KW PA Modules, the Power Combiner, twelve Cooling Fans, the Transmitter RF Cable and High Power Feed, and a 90 degree Coupler. While the PA Assembly is capable of a peak power output of 16 KW, the transmitter design specification requires only 6 KW to achieve the desired height coverage for the radar. Refer to Figure 6-13 for location of the PA Assembly components.



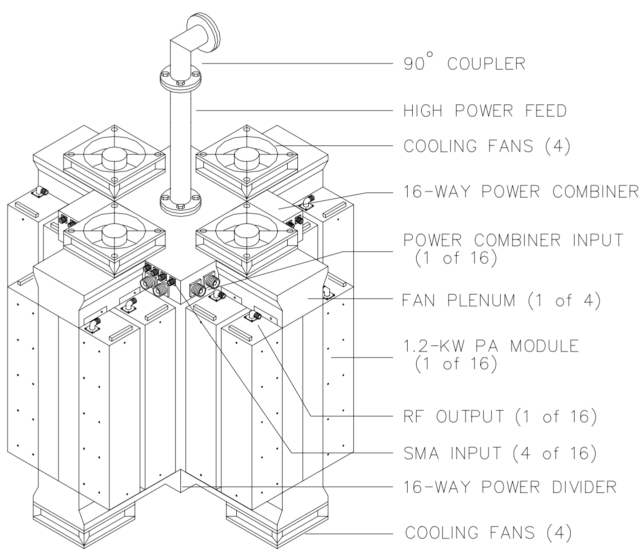


Figure 6-13 Power Amplifier Assembly

6.3.1 16-Way Power Combiner

The 16-Way Power Combiner (PA Combiner) is located inside the PA Cabinet directly above the 1.2-KW PA Modules (see Figure 6-13). Four vertical heat sink extrusions, attached to the Combiner with screws, provide support and cooling for the PA Combiner.

The 16-Way Power Combiner is a high-powered RF Combiner that sums 16 pulsed, in-phase, RF signals from the 1.2-KW Power Amplifier Modules to produce a single output signal. The PA combiner has 16 RF input ports that are merged with micro strip circuits to make four 4.5-KW signals. These signals are then combined to produce the single 16-KW RF output of the transmitter that is routed though a RF Transmitter cable to port 1 of the Circulator.

The sixteen 1.2-KW PA Modules connect to the PA combiner with type "N" female connectors located on the side of the combiner. Sixteen SMA connectors, located above the type "N" connectors, are attached to external balance (dump) resistors that are mounted to the combiner's heat sink extrusions and dissipate out-of-phase signals.

PA Combiner Replacement Procedures

The tools required to perform the PA Combiner replacement are as follows:

- RF (soft-jawed) pliers
- 5/16" open-end wrench
- ½" open- or box-end wrench
- 7/64" Allen wrench
- Phillips-head screwdriver
- Standard screwdriver
- Thermal Joint Compound, EG&G Wakefield, Type 120 or equivalent
- Alcohol (cleaning solution)

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove both side panels from the PA Cabinet, the large blank panel from the front of the cabinet, and the front half of the top panel from the PA Cabinet (see Figure 6-2).

3. Disconnect the brass coaxial transmission line from the Combiner [point (A) in Figure 6-14].

4. Disconnect the sixteen RF lines between the Combiner and the 1.2-KW PA Modules [point (B) in Figure 6-14].

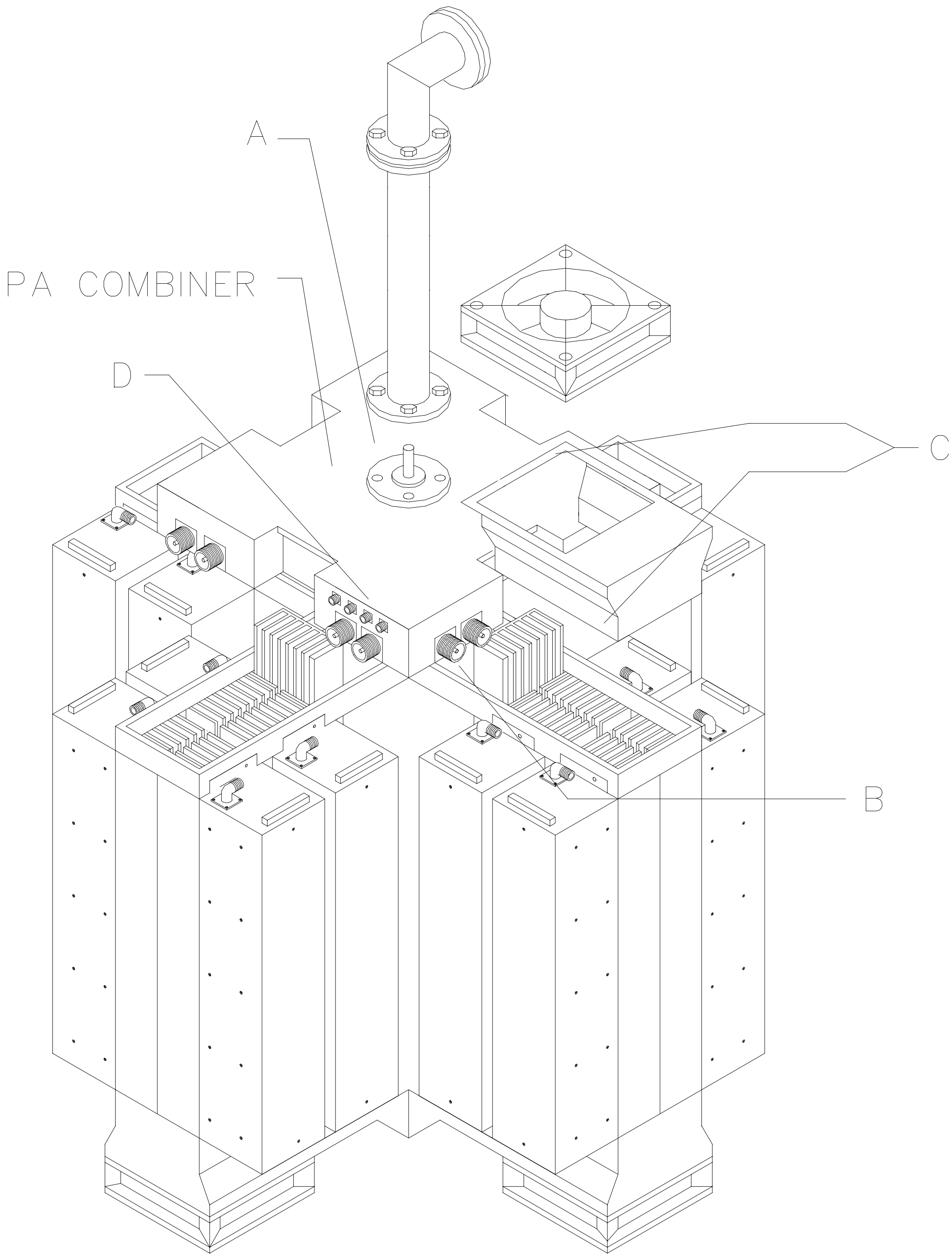


Figure 6-14 16-Way Power Combiner Removal/Replacement

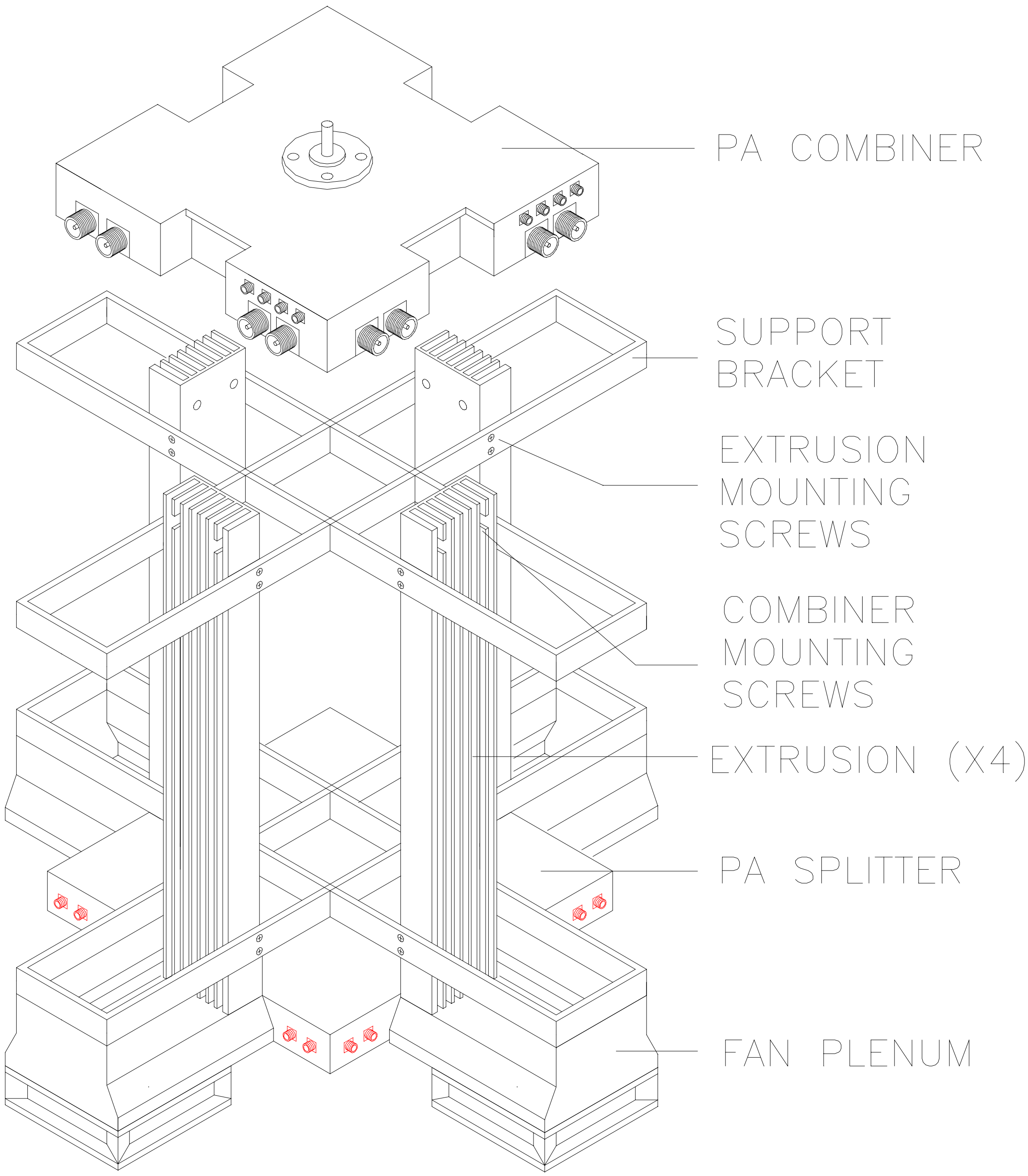


Figure 6-15   16-Way Power Combiner Installation

5. Remove the four top PA Fan Assemblies [point (C) in Figure 6-14].

6. Disconnect the sixteen cables that have SMA connectors from the Combiner [point (D) in Figure 6-14].

7. Disconnect the ribbon-cable and the power cables from the sixteen PA Modules and remove the PA Modules from the PA Cabinet.

8. Remove the eight hex-head screws that attach the Combiner to the four aluminum heat sink extrusions (see Figure 6-15).

9. Remove the PA Combiner by lifting it straight up to separate it from the heat sink extrusions.

10. Remove the screws that attach the heat sink extrusions to the structural cross members and remove the extrusions from the PA Cabinet (see Figure 6-15).

PA Combiner Extrusion Preparation

1. Remove the four external balance (dump) resistors and cables with SMA connectors from each extrusion.

2. Using an alcohol cleaning solution, thoroughly remove the white thermal compound on the bottom of each dump resistor.

3. Apply a very thin layer of thermal compound to the bottom of each dump resistor (one unit at a time) and attach it to the new extrusion supplied with the replacement Combiner. The thermal compound should be no more than 1-2 millimeters thick (thin enough for the aluminum beneath the compound to be visible with only a few streaks of white). If the thermal compound is too thick it is worse than having no compound applied at all.

PA Combiner Installation Procedure

1. Install the new heat sink extrusions in the PA Cabinet, but do not secure them to the cross bracing with mounting hardware.

2. Apply a thin layer (1-2 mm) of thermal compound to the four mounting surfaces of the Combiner where it attaches to the extrusions.

3. Install the Combiner in the PA Cabinet by firmly attaching it to the heat sink extrusions. It is essential to establish a positive mechanical connection between the units to ensure adequate heat dissipation.

4. Install the screws that secure the heat sink extrusions to the cross bracing.

5. Connect the SMA connectors on the cables attached to the dump resistors to the Combiner.

6. Install the top PA Fan Assemblies. Use care not to damage the dump resistor cables.

7. Install the sixteen 1.2-KW PA Modules.

8. Connect all DC and RF cables to the PA Modules and the Combiner.

9. Connect the coaxial transmission line to the Combiner.

10. Verify that the reassembled transmitter is correct, that all fittings are secure, and that all cables are correctly placed. Ensure that the DIP switches on the PA Modules are set according to Figure 6-19 in the next section.

11. Follow the standard power-up sequence described in Section 2.4.

6.3.2 1.2-KW Power Amplifier Modules

The 1.2-KW PA Modules (PA modules) provide RF power to the radar, and are located in the PA Cabinet below the 16-Way Power Combiner (see Figure 6-2). The PA Modules are grouped into four Quads, with four modules per Quad as illustrated in Figure 6-3. Quad 1 contains of PA Modules 1-4, Quad 2 contains modules 5-8, Quad 3 contains PA modules 9-12, and Quad 4 contains modules 13-16. DC power is supplied to the Quads by PA Power Supplies (described in Section 6.4), and cooled by Cooling Fan Assemblies identified in Figure 6-20.

Identifying Faulty Power Amp Modules

Faulty power modules can be identified using the AMP Local Monitor.

1. Set the AMP Local Monitor to LOCAL mode.

2. Use the UP-ARROW/DOWN-ARROW (Increment/Decrement) buttons on the front panel of the AMP Local Monitor to step through all sixteen PA modules.

Record the number of PA Modules that do not indicate power output when the radar is in *HIGH MODE* by observing the *OUTPUT PWR* meter on the front panel of the monitor. If the radar switches beams while performing this procedure, press the *PWR AMP RESET* button on the front panel.

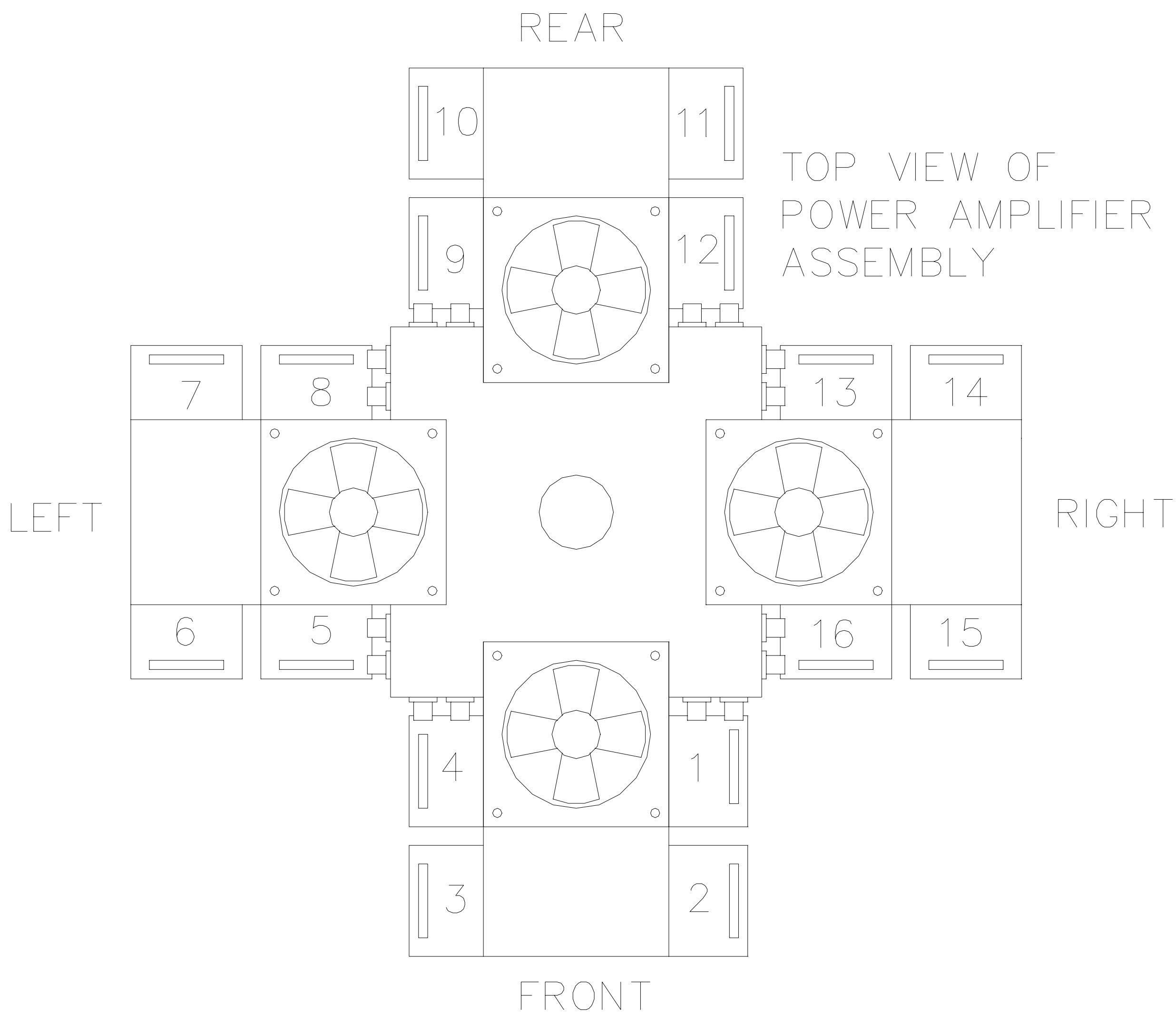


Figure 6-16 Power Amplifier Module Locations

Power Amp Module Replacement Procedures

1. Follow the standard power-down sequence described in Section 2.3.

2. Remove the appropriate panel(s) of the PA Cabinet to provide optimum access to the PA modules to be replaced. Refer to Figure 6-13 for the locations of the PA modules with respect to the PA Cabinet access panels.

3. Unplug the power connector from connector J1 on the bottom of the PA module to be replaced (see Figure 6-17), and disconnect the 'daisy chained' ribbon cable connector J2 on the top of the module.

4. Disconnect the RF input cable from the 16-Way Power Divider, and the RF output cable from the 16-Way Power Combiner, leaving the cables attached to the PA module.

5. Remove the screws from the top and bottom brackets that hold the PA module in place.

6. Remove the PA module from the PA cabinet as shown in Figure 6-18.

7. Prior to installing the new unit in the PA Cabinet, set the module address DIP switches on the new PA module (see Figure 6-19) using a pen or small screwdriver.

   The DIP switch settings are based on the position of the PA module in the transmitter. For the proper DIP switch settings, refer to the sticker on the fan plenum located above the modules slot in the PA Cabinet.

8. Remove the RF input and output cables from the old PA module and transfer them to the new unit. Inspect both connectors after replacement to insure that the connections are tight.

9. Install the new PA module as shown in Figure 6-18 and tighten the mounting screws on the top and bottom of the module.

10. Connect the input and output cables to the 16-Way Power Divider and 16-Way Power Combiner.

11. Connect the 'daisy chained' ribbon cable to connector J2 on the top of the module.

12. Connect the power cable to connector J1 on the bottom of the PA Module.

13. Replace the access panel(s) of the PA Cabinet.

14. Follow the standard power-up sequence described in Section 2.4.

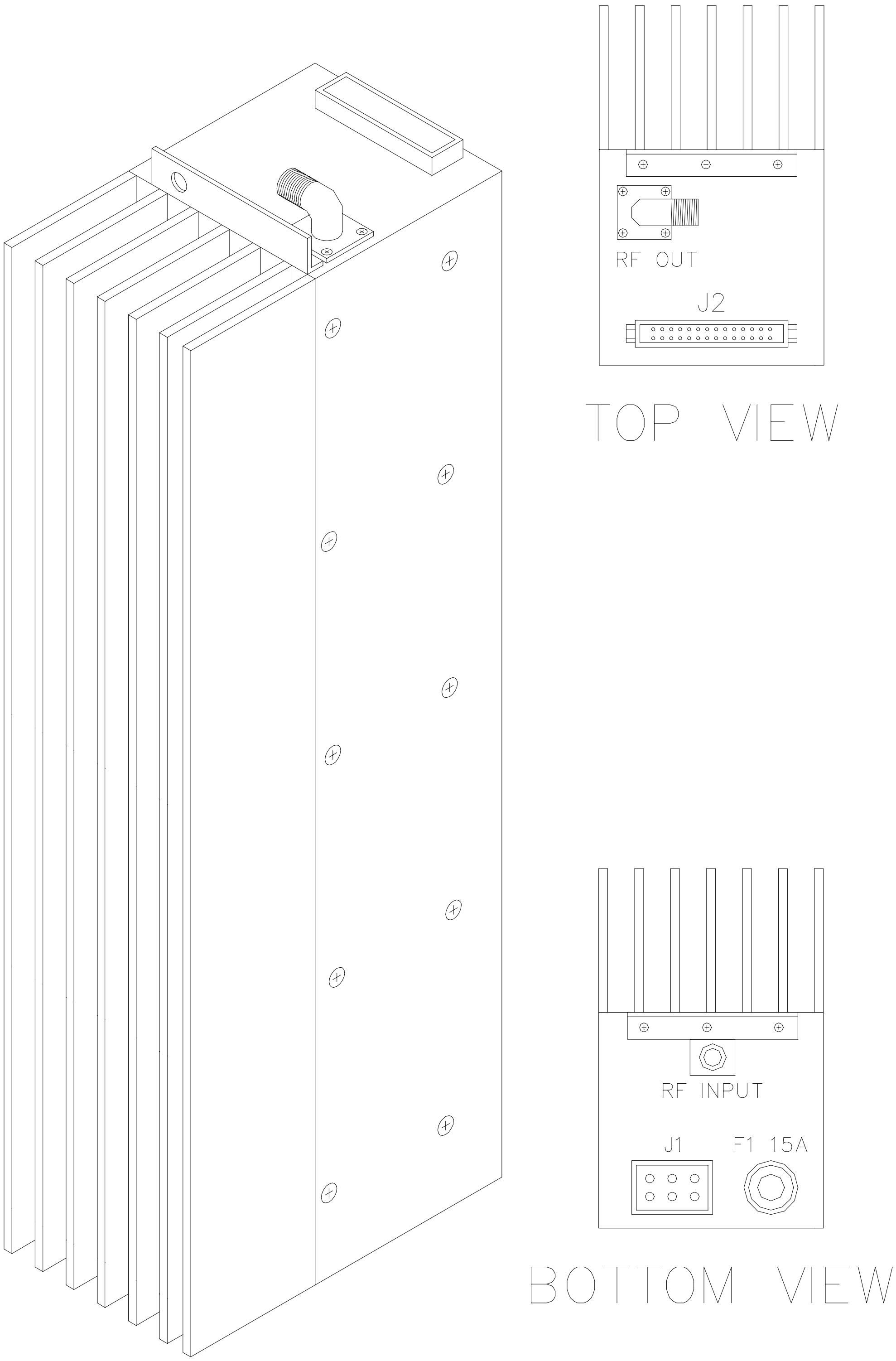


Figure 6-17 Power Amplifier Module Connectors

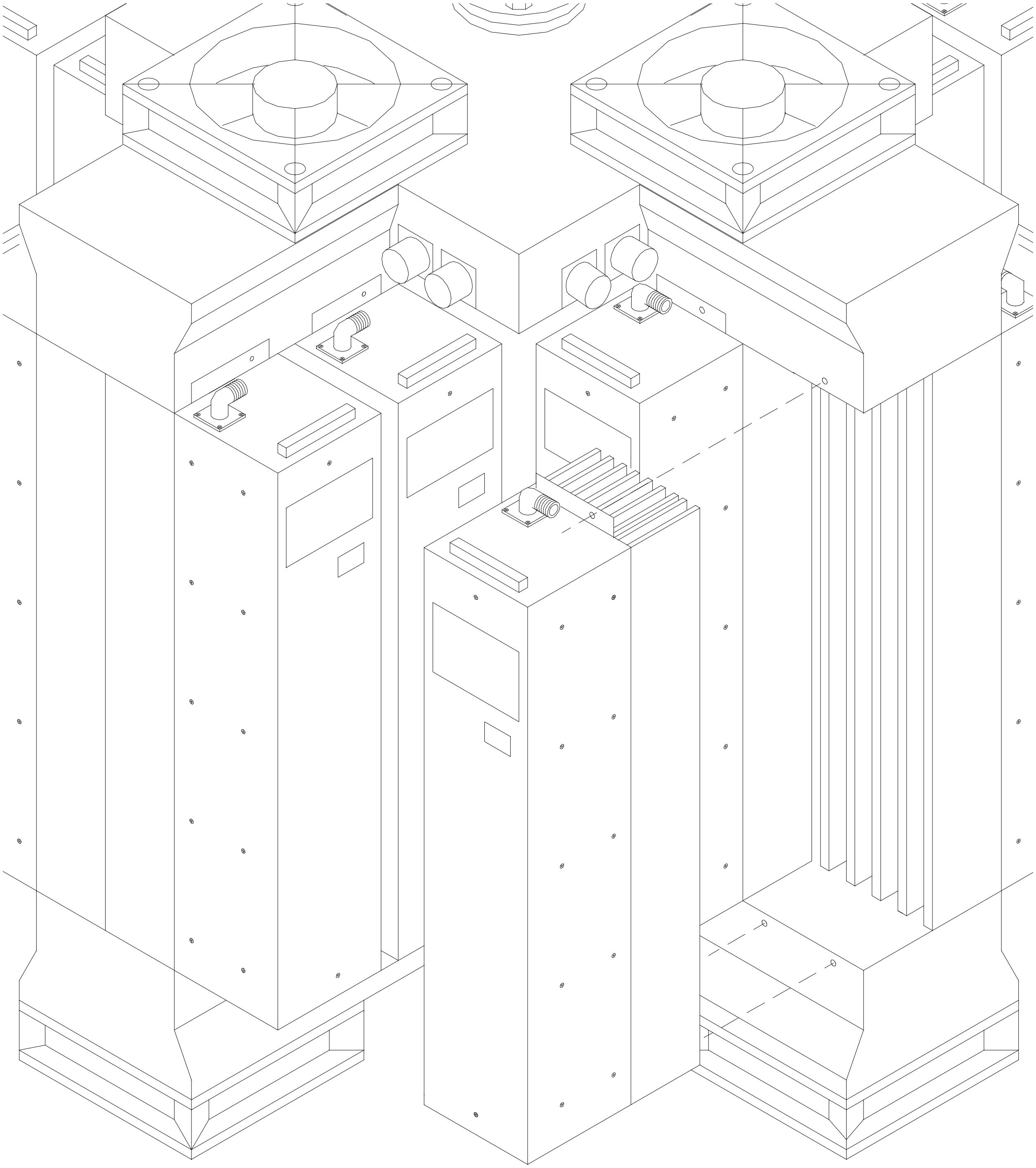


Figure 6-18 Power Amplifier Module Removal/Replacement

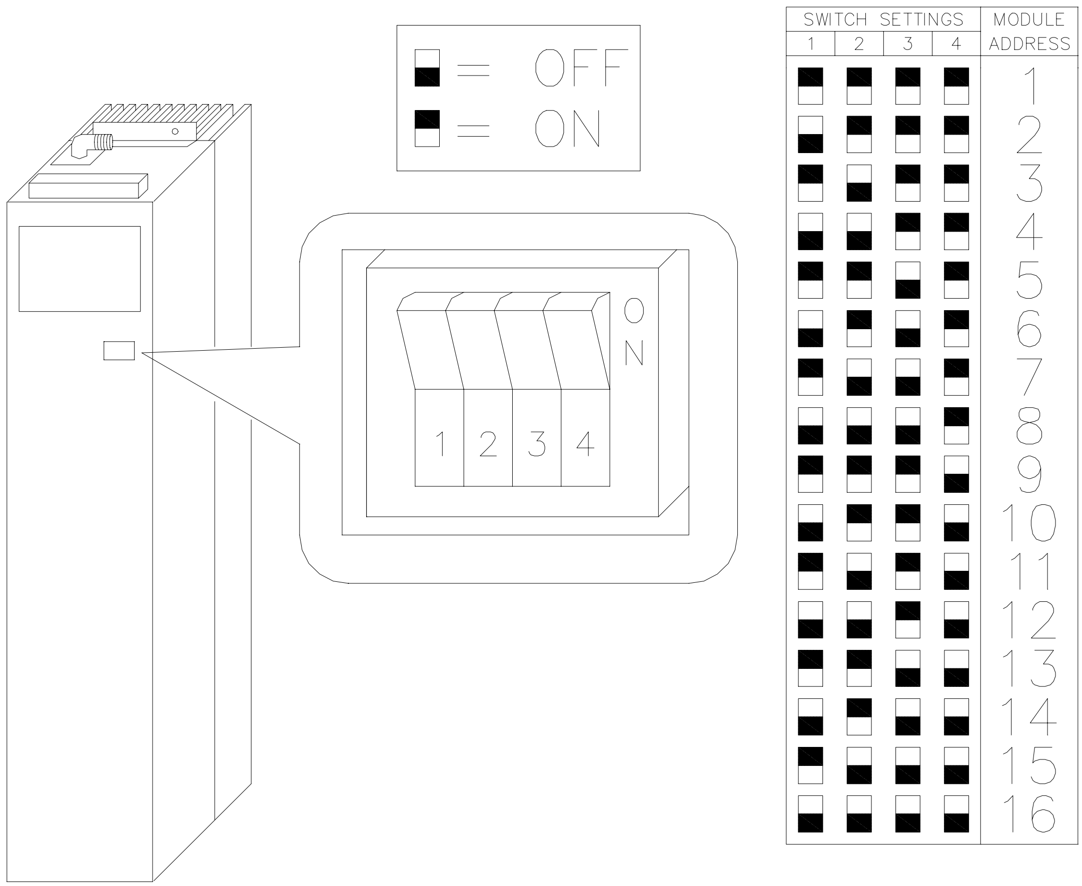


Figure 6-19 Power Amplifier Module Address Switch Settings

15. With the AMP Local Monitor in *LOCAL* mode, use the UP-ARROW/DOWN-ARROW (Increment/Decrement) buttons on the front panel of the AMP Local Monitor to step through all sixteen PA modules to verify the condition of the replaced module.

6.3.3 Power Amplifier Cooling Fans

The PA Cabinet contains twelve fans to cool the sixteen 1.2-KW PA Modules and the 16-Way Power Combiner (see Figure 6-20). Each of the four PA Quads has a Cooling Fan Assembly, consisting of three fans wired in parallel, allocated to it. Two of the fans in each assembly are located above and below the Quad, and the third is mounted at the top of PA Cabinet above the Quad. The numbers in Figure 6-20 correspond to the designations of the PA Quads and PA Power Supplies.

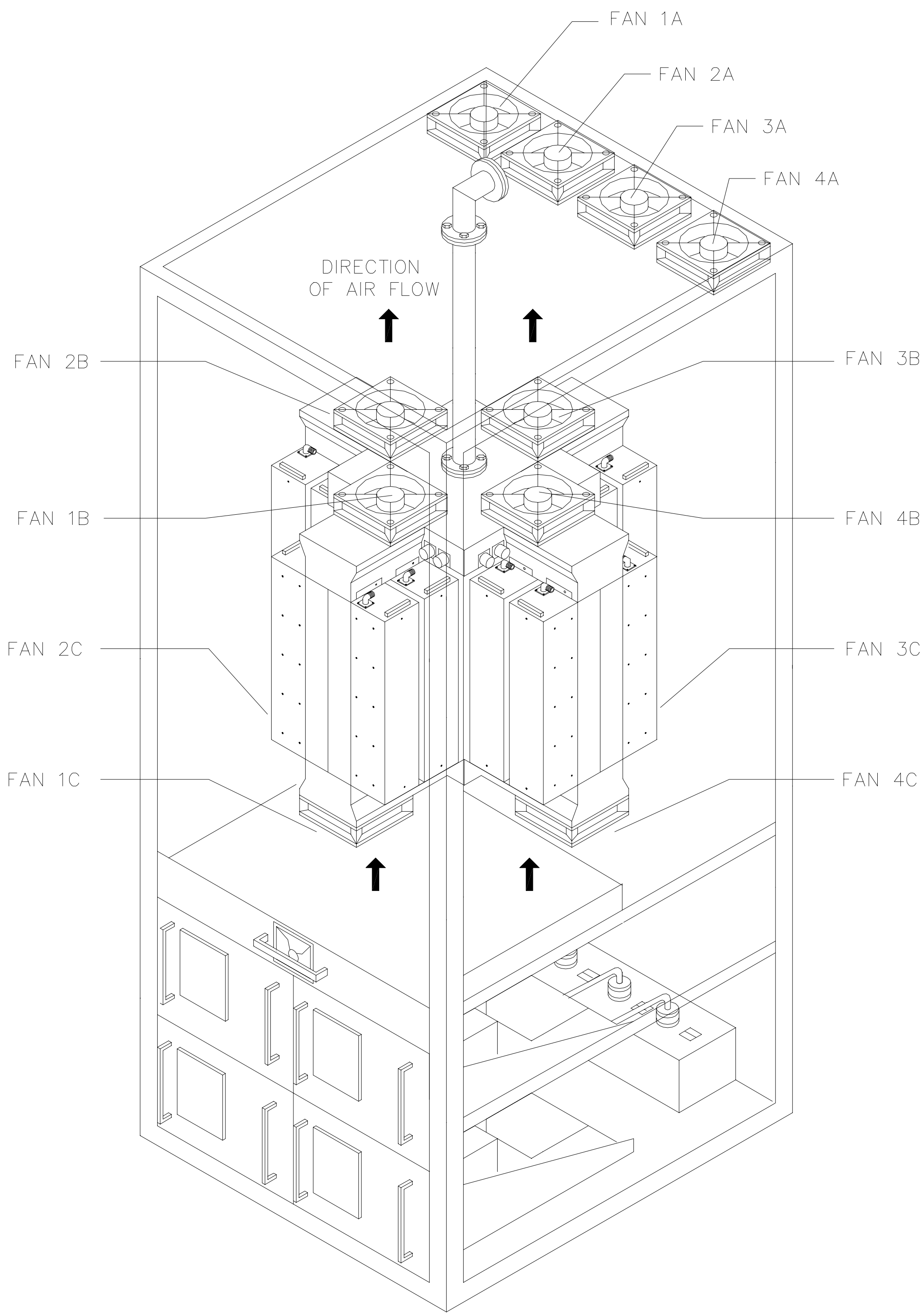


Figure 6-20 PA Cabinet Cooling Fan Assemblies

6.3.3.1 Fan Fault Indications

Each cooling fan assembly is powered by +12 VDC from one of four Power Amplifier Power Supplies. The amount of current drawn by a group of fans is measured by a Monitor Board located in the associated PA Power Supply drawer referenced in Section 6.4.3. If the current drawn by the fans rises above (or falls below) a specified limit, the Monitor Board triggers a *FAN FAULT* indication on the front panel of the AMP Local Monitor (see Figure 6-4).

If all cooling fans in a group are known to be operational and a *FAN FAULT* is indicated on the AMP Local Monitor, either the circuit on the Monitor Board needs to be adjustment or the Monitor Board is faulty. Refer to Section 6.4.3.1 for the adjustment procedures for the Monitor Board Fan Current Circuit. If the Monitor Board is faulty, the entire PA Power Supply drawer should be replaced.

6.3.3.2 Locating Failed Cooling Fans

1. Remove the side panels from the PA Cabinet.

2. Perform a visual inspection of the cooling fans to verify that they are turning under power. Carefully evaluate the fans directly above and below Quads1-4. The air flow in the PA Cabinet can cause a malfunctioning fan to spin, making it appear to be operating properly. To confirm that the fan is operating under power, apply pressure to the center of the fan using your finger or a pencil eraser. The direction of air flow for the cooling fans is indicated in Figure 6-20.

3. When a malfunctioning fan is located, disconnect the power connector from the fan and measure the voltage at the power connector. A measurement of +12 VDC at the power connector indicates a faulty fan that must be replaced using the procedures in the next section.

   If a measurement of approximately +12 VDC is not indicated one of following may be causing the problem:

   a. The +12 VDC power supply has failed in the PA Power supply.
   b. There is a faulty connection between the power supply and the fan.
   c. One of the other fans connected to the PA Power supply is loading-down the +12 VDC power supply.

A process of elimination should be used to identify the faulty component; refer to Section 6.4 for additional information on the PA Power Supplies.

6.3.3.3 Cooling Fan Replacement Procedures

1. Disconnect the power connector from the fan.
2. Remove the four mounting screws from the fan and remove the fan.
3. Temporarily connect the new fan to the power connector to verify correct operation and to determine that the direction of air flow caused by the fan conforms with the direction identified in Figure 6-20.
4. Disconnect the power connector from the fan and install the fan so that air flows from the bottom to the top of the PA Cabinet.
5. Reconnect the power connector to the fan.
6. Verify that the *FAN FAULT* LED has cleared on the front panel of the AMP Local Monitor. If the *FAN FAULT* LED is still illuminated, refer to Section 6.4.3.1 for the adjustment procedures for the Monitor Board Fan Current Monitor Circuit.
7. Replace the side panels of the PA Cabinet.

6.4 Power Amplifier Power Supplies

Four identical Power Amplifier (PA) Power Supplies (numbered 1 through 4) are located in four drawers at the base of the PA Cabinet as illustrated in Figure 6-1 and Figure 6-2. The front panel of a PA Power Supply is shown in Figure 6-21.

The PA Power Supplies provide DC power to the PA Modules, Cooling Fan Assemblies, Dual RF Driver, and Amp Local Monitor. Each PA Power Supply Drawer provides power to specific transmitter components to minimize the impact of a power supply failure on the operation of the radar. For example, PA Quads (1-4) and Cooling Fan Assemblies (1-4) are powered by PA Power Supplies 1 - 4. Redundant power is supplied to critical LRUs, such as the AMP Local monitor and the RF Dual Driver, to increase reliability. For example, PA Power Supplies 1 and 2 and PA Power Supplies 3 and 4, supply power to the AMP Local Monitor and to Drivers A and B, respectively. Figure 6-22 illustrates the distribution of power to LRUs within the PA Cabinet.

Each PA Power Supply Drawer contains three subsidiary power supplies (+37.5 VDC, +12 VDC, and +5 VDC) and a PA Power Supply Monitor Board. These are identified in Figure 6-20.

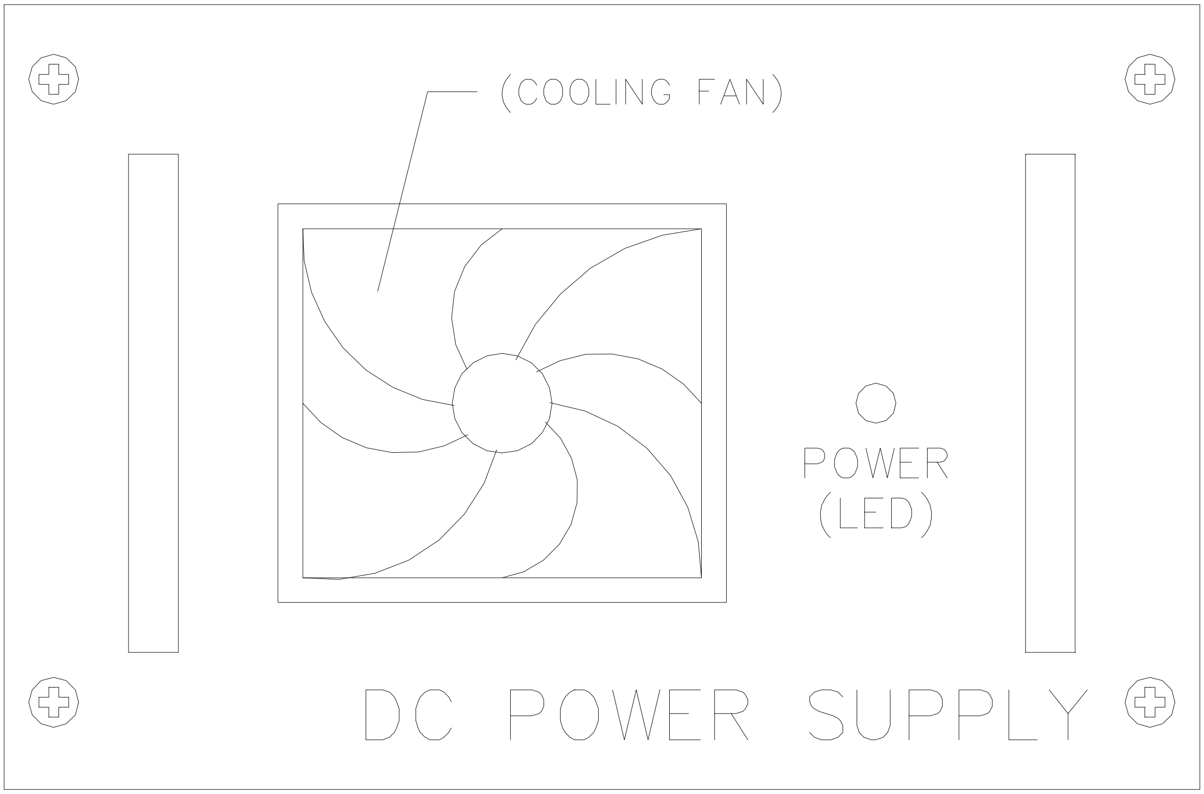


Figure 6-21 PA Power Supply Front Panel

6.4.1 Isolating Faulty Power Supplies

The profiler remote diagnostic feature has the ability to report the number of failed PA Power Supplies but not which of the four units is faulty. The task of isolating a PA Power Supply fault must be accomplished manually by using the AMP Local Monitor, a Digital Volt Meter (DVM), and basic troubleshooting techniques.

The diagnosis of a Power Supply fault is not always a straight-forward process. For example, if both PA Power Supplies 1 and 2 fail, the AMP Local Monitor would be rendered inoperative and could not be used to identify failed LRUs. In such cases, DVM measurements and systematic troubleshooting skills must be used to identify failed LRUs.

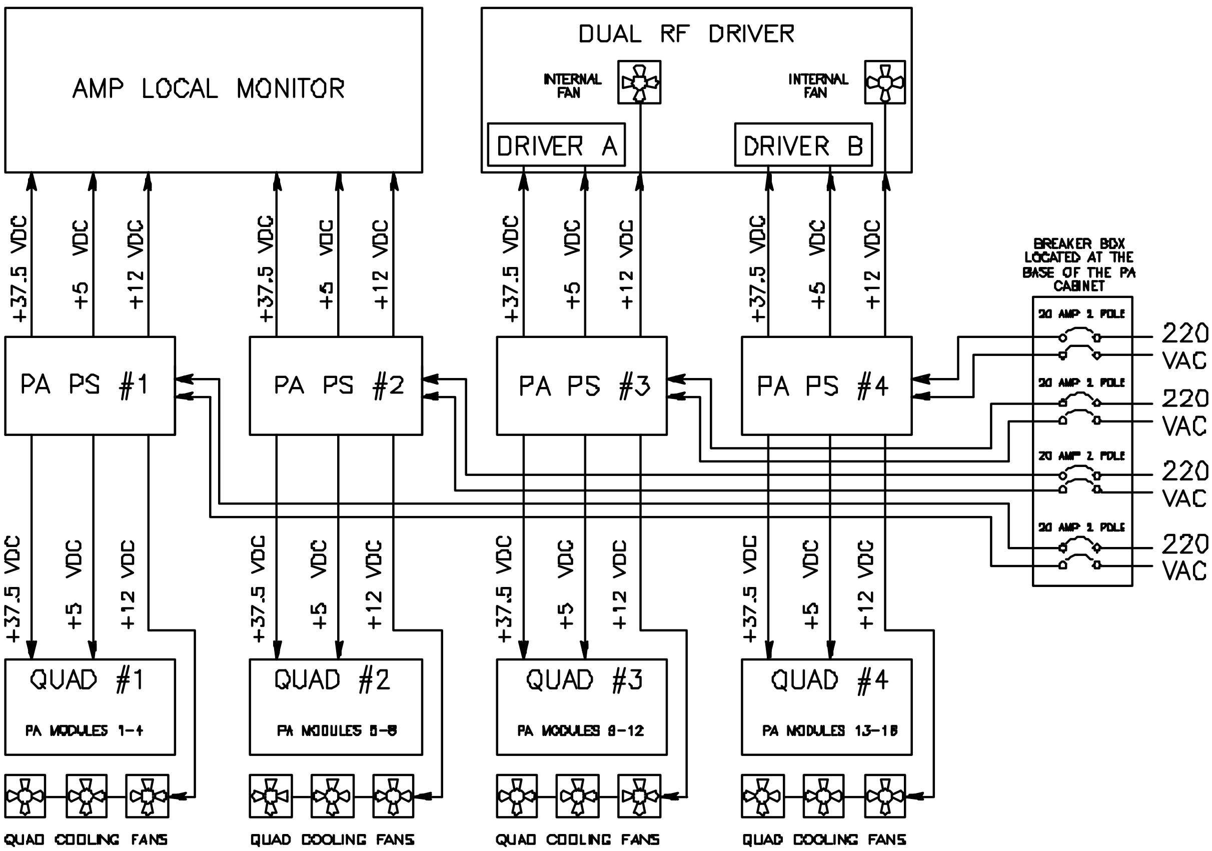


Figure 6-22 PA Cabinet Power Distribution

1. The most obvious indication of a PA Power Supply fault is the illumination of one or more of the *QUAD PS FAULT* LED(s) on the front panel of the Amp Local Monitor (see Figure 6-4). If an LED is illuminated, use a DVM to check the output voltages of the Subsidiary Power Supplies in the drawer corresponding to the number of the illuminated LED. Voltage measurements can conveniently be made at the terminal blocks in the PA Cabinet identified in Figure 6-23.

   To gain access to the PA Power Supply terminal strips, remove the side panels from the PA Cabinet. To gain access to the PA Power Supplies, remove the inner cover panels from the lower part of the PA Cabinet.

   If there is no voltage output from any of the subsidiary power supplies, a power supply breaker may have been tripped (each PA Power Supply has its own breaker). Power cycle the appropriate breaker located inside the PA Cabinet at the base (see Figure 6-2). If one or all the subsidiary power supplies remain failed after the power cycle, replace the PA Power Supply.

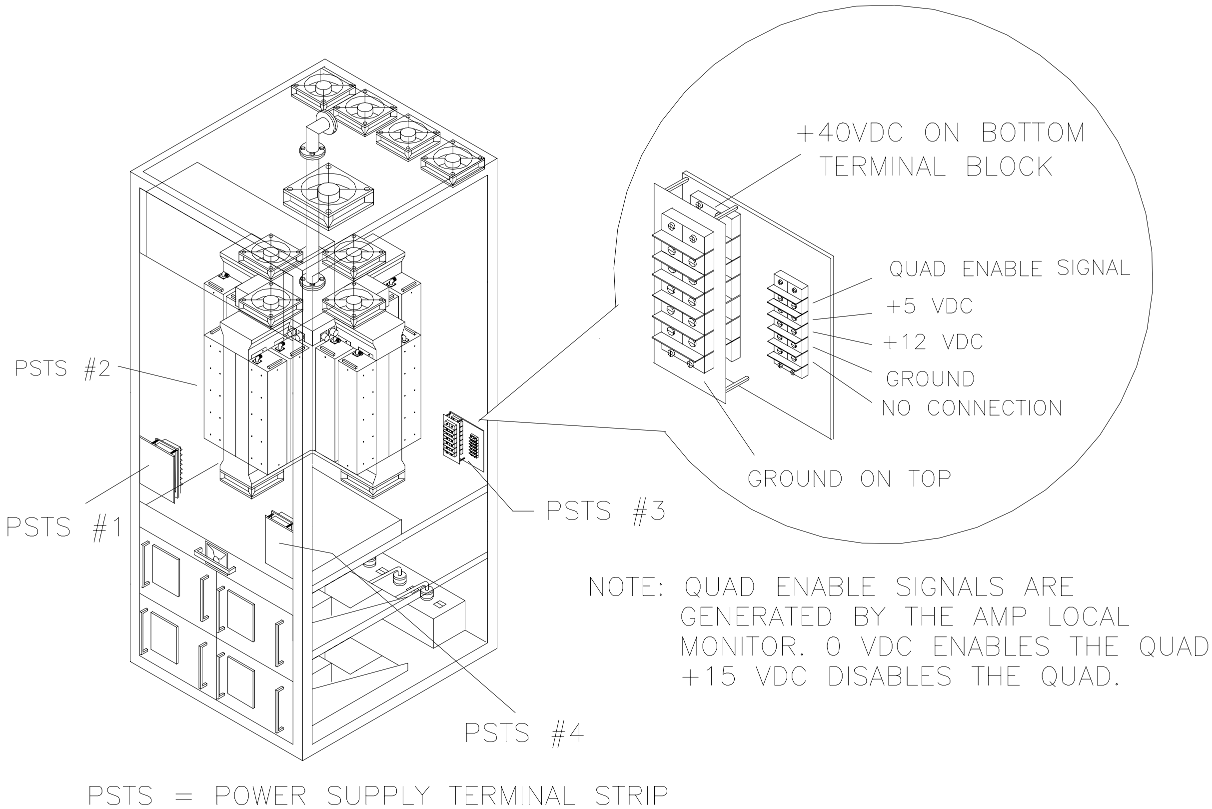


Figure 6-23 Power Supply Terminal Strip Locations and Designations

2. If all subsidiary power supplies have the correct voltage levels, the Power Supply Monitor Board may be faulty and should be checked. Refer to Section 6.4.3 for the troubleshooting procedures for the Monitor Board. If the Monitor Board is faulty, the entire PA Power Supply should be replaced.

3. If the correct voltage levels are being output by the Monitor Board, check the connections to the AMP Local Monitor.

4. If the connections to the AMP Local Monitor are good, the AMP Local Monitor may be faulty. Perform a power cycle of the PA Cabinet. Put the AMP Local Monitor in *LOCAL* mode and press the *LAMP TEST* button. If the symptoms still exist or the AMP Local Monitor fails the *LAMP TEST*, replace the AMP Local Monitor.

5. Once a failed LRU has been identified, it is advisable to continue checking the remaining LRUs for any other problems that may exist.

6.4.2 Power Amplifier Power Supply Replacement Procedures

1. Follow the standard power-down sequence described in Section 2.3.

2. Disconnect the PA Power Supply AC power cord from the breaker outlet box [cable (A) in Figure 6-24].

3. Disconnect the two power output connectors from the rear of the power supply Monitor Board [points (B) and (C) in Figure 6-24].

4. Using a small flat-blade screwdriver, loosen the fastening screws and disconnect the "D" sub-miniature connector from the rear of the power supply Monitor Board [point (D) in Figure 6-24].

5. Using a small adjustable wrench, loosen the nuts on the main DC output terminals of the PA Power Supply [points (E) and (F) in Figure 6-24] and remove the heavy-gauge red and black wires from the lugs.

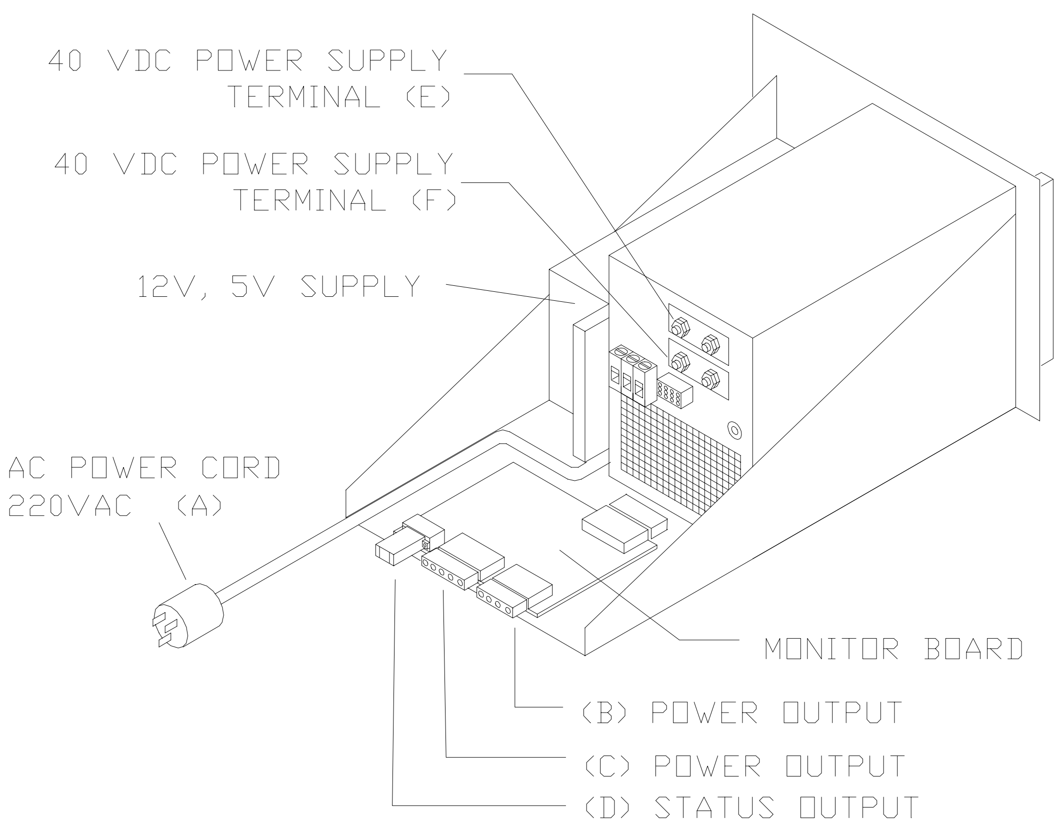


Figure 6-24 PA Power Supply Drawer Component Layout

6. Remove the four mounting screws from the front panel of the PA Power Supply. Slide power supply out the front of PA Cabinet.

7. Install the replacement power supply and replace the four mounting screws on the front panel.

8. Reconnect the heavy-gauge red and black wires at points (E) and (F) in Figure 6-24. The red wire connects to the positive terminal and the black wire connects to the negative terminal.

9. Reconnect connectors B, C, and D to their respective ports as shown in Figure 6-24. Use a small screwdriver to tighten the fastening screws of the "D" sub-miniature connector.

10. Plug the AC power cord (cable A in Figure 6-24) into the breaker outlet box at the base of the PA Cabinet.

11. Follow the standard power-up sequence described in Section 2.4.

12. Use a DVM to measure the voltage at the terminals of the 40 VDC subsidiary power supply; the voltage should be 37.5 VDC. If the voltage is out of specification, use a small, flat-blade screwdriver to adjust the trim potentiometer (pot) on the back of the 40 VDC supply. Refer to Figure 6-25 for location of the voltage adjustment trim pot.

13. Use the AMP Local Monitor to verify proper operation of the power supplies and associated PA modules. Check the operation of all of the PA cooling fans. If all fan assemblies are functioning and a *FAN FAULT* is indicated on the front panel of the AMP Local Monitor, adjust the Fan Current Monitor circuit on the PA Power Supply's Monitor Board (see Section 6.4.3.1).

    Test the fan monitor circuit by disconnecting the power plug from one of the fan assemblies associated with newly replaced PA Power Supply. If a *FAN FAULT* indication does not appear on the AMP Local Monitor, adjust the Fan Current Monitor circuit on the PA Power Supply's Monitor Board (see Section 6.4.3.1).

14. Replace the inner cover panels on the lower part of the PA Cabinet.

15. Replace the side panel(s) of the PA Cabinet.

16. Return the AMP Local Monitor to remote mode.

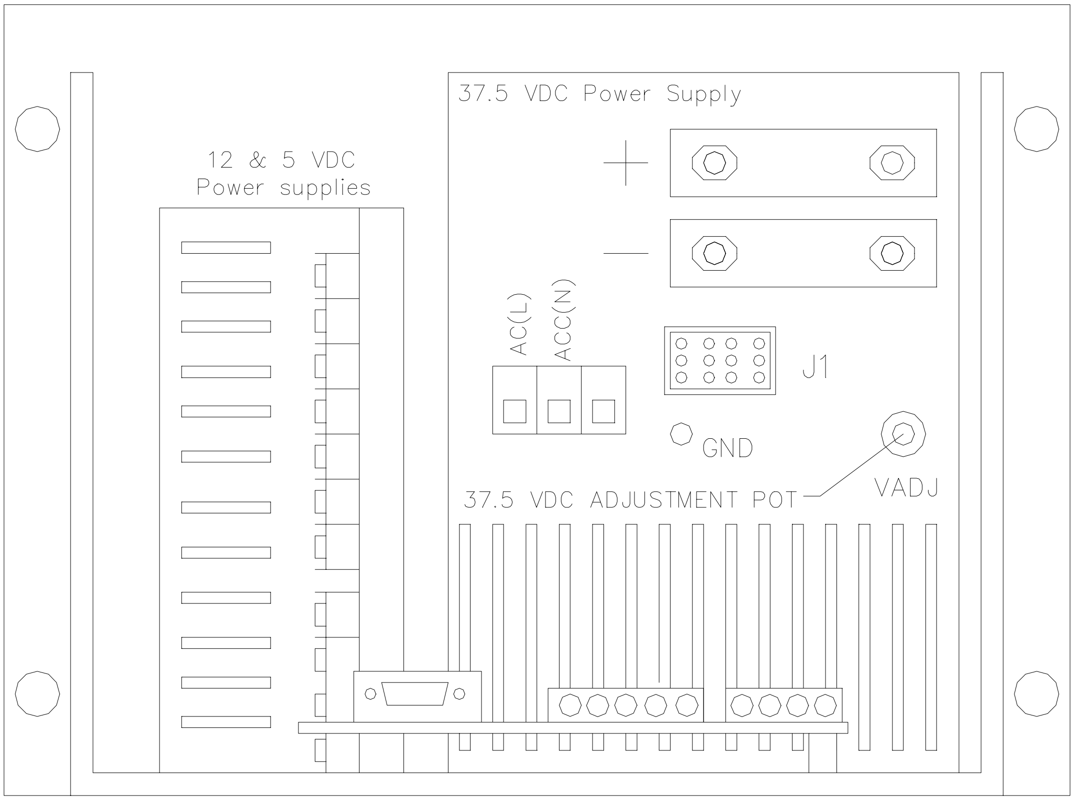


Figure 6-25 PA Power Supply Rear Panel

6.4.3 PA Power Supply Monitor Board

Each PA Power Supply drawer has an integral Monitor Circuit Board. The Monitor Board is located at the back of the supply drawer and draws its power from the 37.5 VDC subsidiary power supply. Power distributed to the various transmitter components from the PA Power Supply is routed through the Monitor Board, which performs the following functions:

- Measures the output voltages of the three subsidiary power supplies and transmits a message to the Amp Local Monitor if the output voltages fall outside a defined range.

- Measures the current drawn by the Cooling Fan Assembly that is associated with the PA Quad supplied by the PA Power Supply, and transmits a message to the AMP Local Monitor if the current falls outside a defined range.

- Routes shutdown commands from the Amp Local Monitor to the four 2-KW PA modules in the quad powered by the PA Power Supply.

An understanding of the operation of the PA Power Supply Monitor Board is required for adjusting the Monitor Board circuit and troubleshooting malfunctions. The following discussion is organized according to the functions identified above. Refer to Figure 6-23 for the Monitor Board component layout and Figure 16-24 for the Monitor Board schematic diagram.

Monitoring the Output Levels of the 40 VDC, 12 VDC, and 5 VDC Subsidiary Power Supplies.

Power supply monitoring is accomplished with three window comparators that have "open collector outputs", logically OR-ed together through a common pull-up resistor. The thresholds of the windows are set with fixed resistor voltage dividers. If voltages of any of the Subsidiary Power Supply exceed the threshold voltage of the window, the comparator common output will be pulled to ground. The outputs of the comparators are fed into a logic inverter and then into one input of a two-input logic NOR gate. The second input of this gate is driven to a logic "high" by the AMP Local Monitor when the LAMP TEST button on the front panel of AMP Local Monitor is pressed. The output of the NOR gate drives the base of a NPN transistor, which in turn signals the AMP Local Monitor that there is a fault.

Monitoring the Current Drawn by a Cooling Fan Assembly.

Monitoring the current drawn by a Cooling Fan Assembly is accomplished by measuring the voltage drop across a 0.1-ohm resistor in series with the three fans wired in parallel. The voltage drop across the resistor is fed into a differential amplifier with a fixed gain, and the input voltage is adjusted via trim pot R5 (see Figure 6-26 and Figure 6-27).

The output of the differential amplifier drives two circuits: a window comparator that tells the AMP Local Monitor if too much (or too little) current is being drawn by the fan assembly, and a voltage-follower amplifier that tells the AMP Local Monitor how many PA fans have failed.

Routing Signals to the PA Modules.

The Monitor Board routes Quad shutdown signals from the AMP Local Monitor to the associated PA modules. This is a passive process because there are no active circuits involved in routing the control signals to the Quad. Only a trace appears on the Monitor Board.

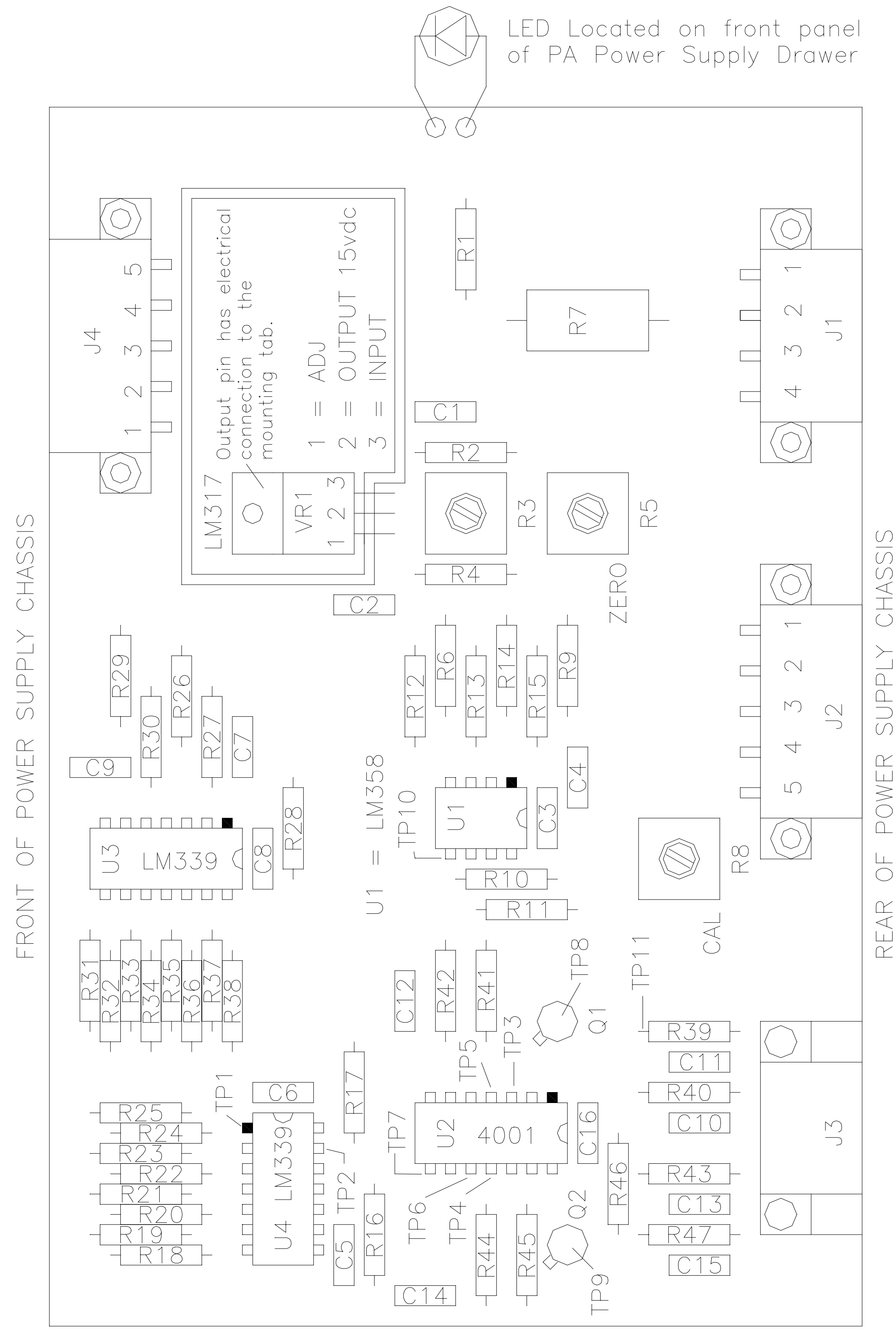


Figure 6-26 Power Supply Monitor Board Component Layout

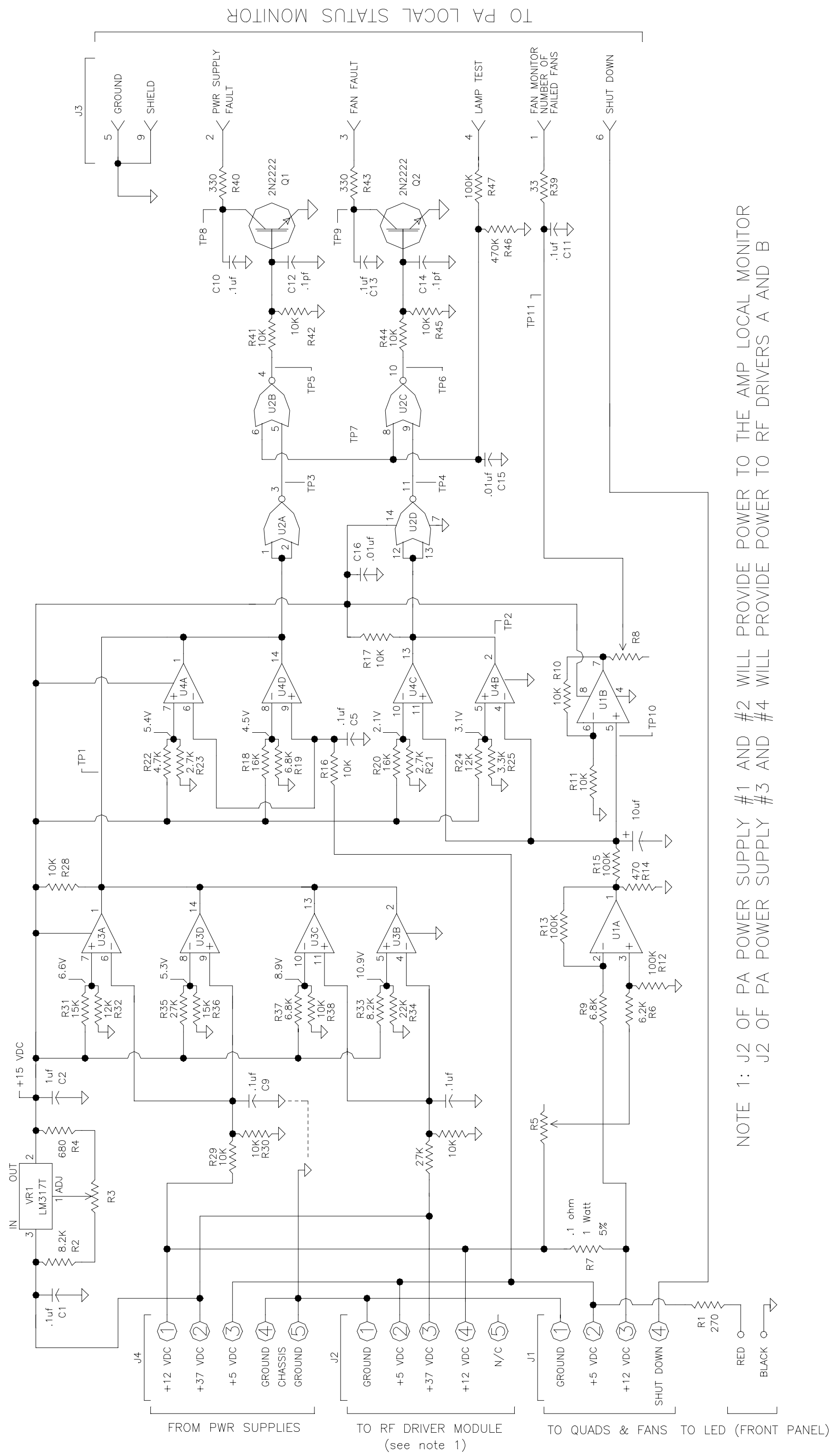


Figure 6-27   Power Supply Monitor Board Schematic Diagram

6.4.3.1 Adjusting the Monitor Board Fan Current Circuit

1. Verify that all three fans in the Cooling Fan Assembly are operating properly.

2. Verify that the voltage regulator on the Monitor Board is operating properly. The output voltage at pin 2 (which has electrical contact with the mounting base) of VR1 should be +15.00 VDC. Use trim pot R3 to adjust the output of VR1, if necessary. Because the printed circuit board power ground plane and chassis ground are connected, the power supply chassis can be used as a ground reference.

3. Measure the voltage at TP10 and use trim pot R5 to adjust the voltage to 2.4 VDC (±0.05 VDC).

4. Measure the voltage at TP11 and use trim pot R8 to adjust the voltage to +1.9 VDC (±0.05 VDC).

6.4.3.2 Monitor Board Troubleshooting

Power Supply Monitor

1. Verify the proper operation of the 40V, 12V, and 5V power supplies.

2. Verify the proper operation of the voltage regulator on the Monitor Board. The output voltage at pin 2 (or at the mounting base) of VR1 should be 15 VDC. Use trim pot R3 to adjust the output of VR1, if necessary. Note that the power ground (plane) and the drawer chassis ground are connected, so the power supply chassis can be used as a ground reference.

3. Measure the voltage at TP1 on the Monitor Board and verify that it is approximately 15 VDC.

4. Measure the voltage at TP3 and verify that it is approximately 0 VDC.

5. Measure the voltage at TP5 and verify that it is approximately 15 VDC.

6. Measure the voltage at TP7 and verify that it is approximately 3.8 VDC.

7. Measure the voltage at TP8 and verify that it is approximately 0 VDC.

Fan Current Monitor Circuit

1. Verify that all twelve quad cooling fans in the PA Cabinet are functioning properly. If all fans are operating properly, measure the voltage at TP10. Use trim pot R5 to adjust this voltage to 2.4 VDC.

2. Measure the voltage at TP11 and use trim pot R8 to adjust this voltage to 1.9 VDC.

3. Measure the voltage at TP2 and verify that it is approximately 15 VDC.

4. Measure the voltage at TP4 and verify that it is approximately 0 VDC.

5. Measure the voltage at TP6 and verify that it is approximately 15 VDC.

6. Measure the voltage at TP9 and verify that it is approximately 0 VDC.

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7 404 MHz Radar Antenna System

The wind profiler antenna subsystem employs co-axial co-linear array elements to achieve the required antenna performance. Refer to Table 7-1 for antenna performance parameters. No active devices are located in the open environment thus providing a highly reliable design.

The antenna subsystem is formed from two coaxial co-linear arrays arranged orthogonal to each other to form a vertical, a North, and an East beam (see Figure 7-1). Physically, the two arrays occupy an area 40 feet by 40 feet. Each array is formed from 20 rows of coaxial co-linear array subassemblies fed by series of power dividers (5:1, 4:1, 3:1 and 2:1 power dividers). These antenna elements, with a row spacing of 0.711 wavelength enables the generation of a scanned beam to 16.34 degrees off axis with only two sets of five discrete phase delay cables.

A ground plane formed by corrosion-resistant expanded steel mesh is positioned a quarter wavelength below the arrays on the 40 x 40 foot frame. The ground plane is located approximately 3.5 feet above the ground to minimize the effect of snow accumulation and to facilitate antenna installation and repair.

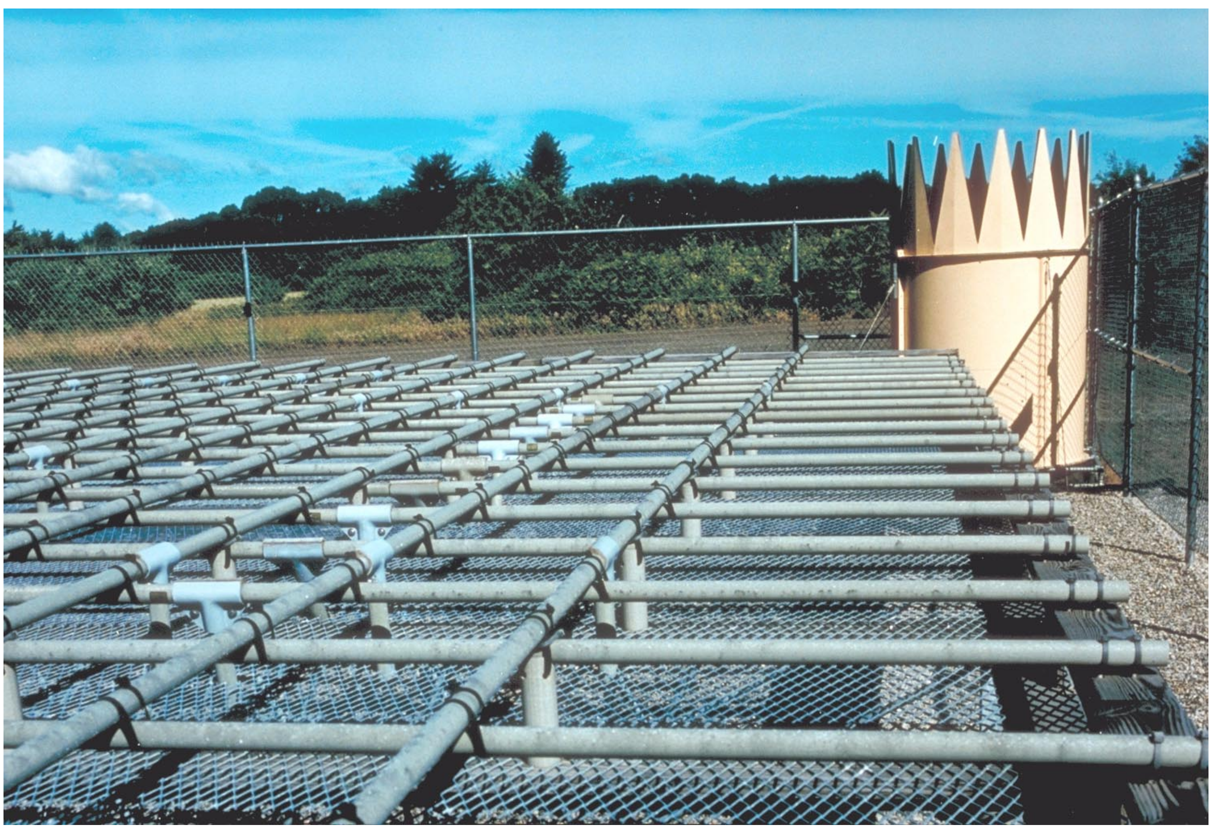


Figure 7-1 404 MHz Antenna Array

Table 7-1 Antenna Performance Parameters

Parameter	Value
Frequency	404.37 MHz + 0.5 MHz
One-way 3 dB beam-width (all beams)	< 5^o
One-way peak side-lobe levels (all beams) For elevation angle $\geq$45 degrees For 5 degrees < elevation angle < 45 degrees For elevation angle $\leq$ 5 degrees	 < -20 dB relative to < -25 dB on axis $\leq$ -40 dB beam peak
On-axis gain above isotropic	$\geq$32 dB
Number of beams	3 (sequential)
North and East beam elevation angles	73.7 degrees
Vertical beam elevation angle	90.0 degrees
Beam switching speed	$\leq$ 0.4 sec
Maximum beam pointing error from nominal position Elevation (0)	 $\pm$ 0.5E
Azimuth (0)	$\pm$ 2.0E
Input VSWR	<1.2:1 max

The antenna has three major components; antenna arrays, power dividers and cables, and beam selection electronics. Each of these components is discussed in the following sections.

7.1 Coaxial Co-linear Array Subassemblies

Each co-linear array subsection is a resonant array. This system uses two styles of co-linear subarrays as shown in Figure 7-3. The east-west (Array #1) and north-south (Array #2) antennas are similarly constructed using these two styles. The coaxial dipole elements are formed from sections of high impedance coaxial cable, each a half-wavelength in the coaxial line as shown in Figure 7-2. The completed coaxial subassembly is packaged within a cylindrical fiberglass radome 1-3/4 inches in diameter. The radome provides protection and forms a weather-tight seal around the elements.

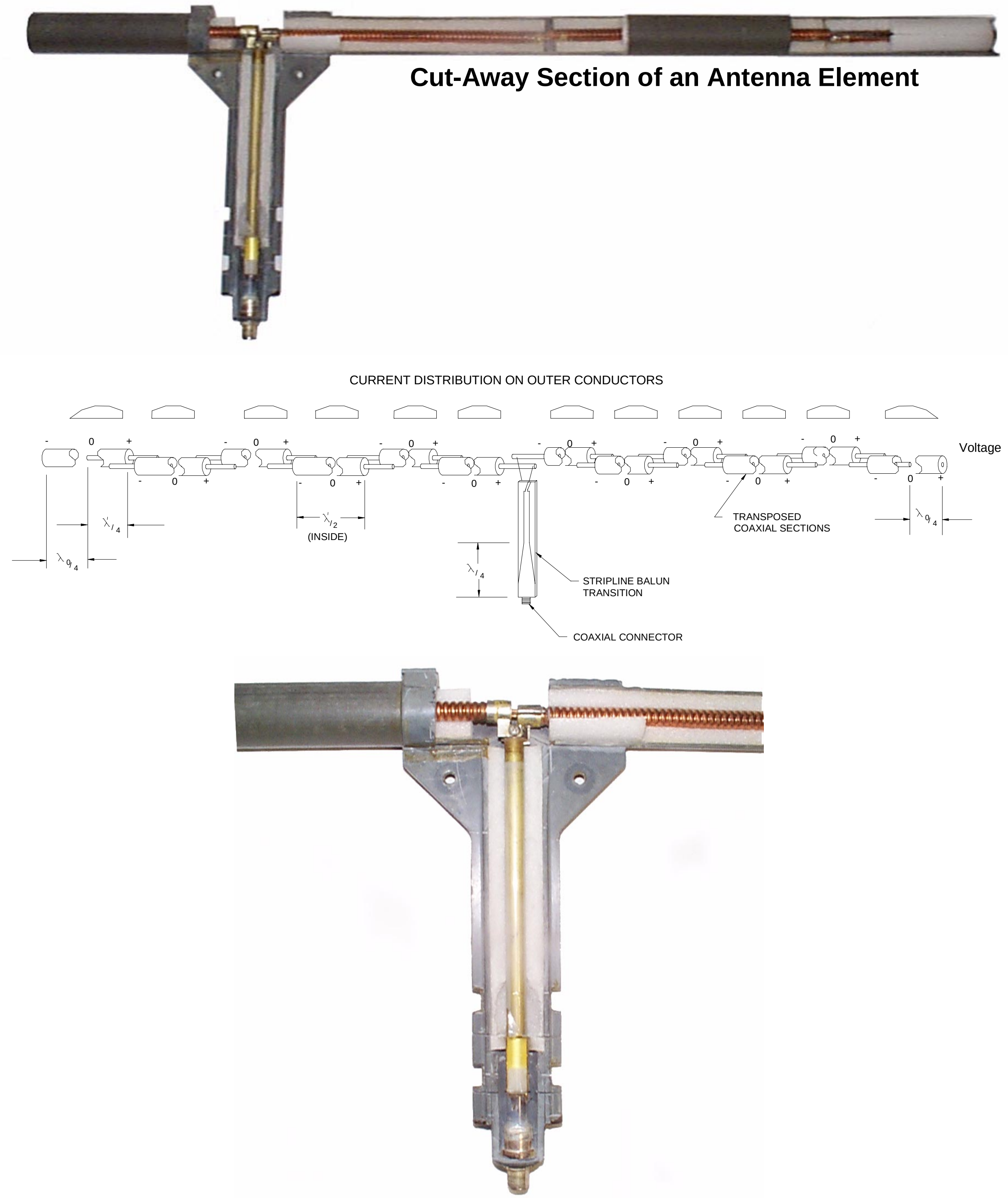


Figure 7-2 Coaxial Dipole Antenna Element

Each array uses 10 style 1 subassemblies consisting of two 14-element co-linear subsections fed by a 2:1 power divider, as shown in top half of Figure 7-3. Each array also uses 10 style 2 subassemblies consisting of two 12-element and one 14-element co-linear subsection fed by 3:1 power divider as shown in bottom half of Figure 7-3. The completed assemblies are approximately 1-3/4 inches in diameter and 40 feet long.

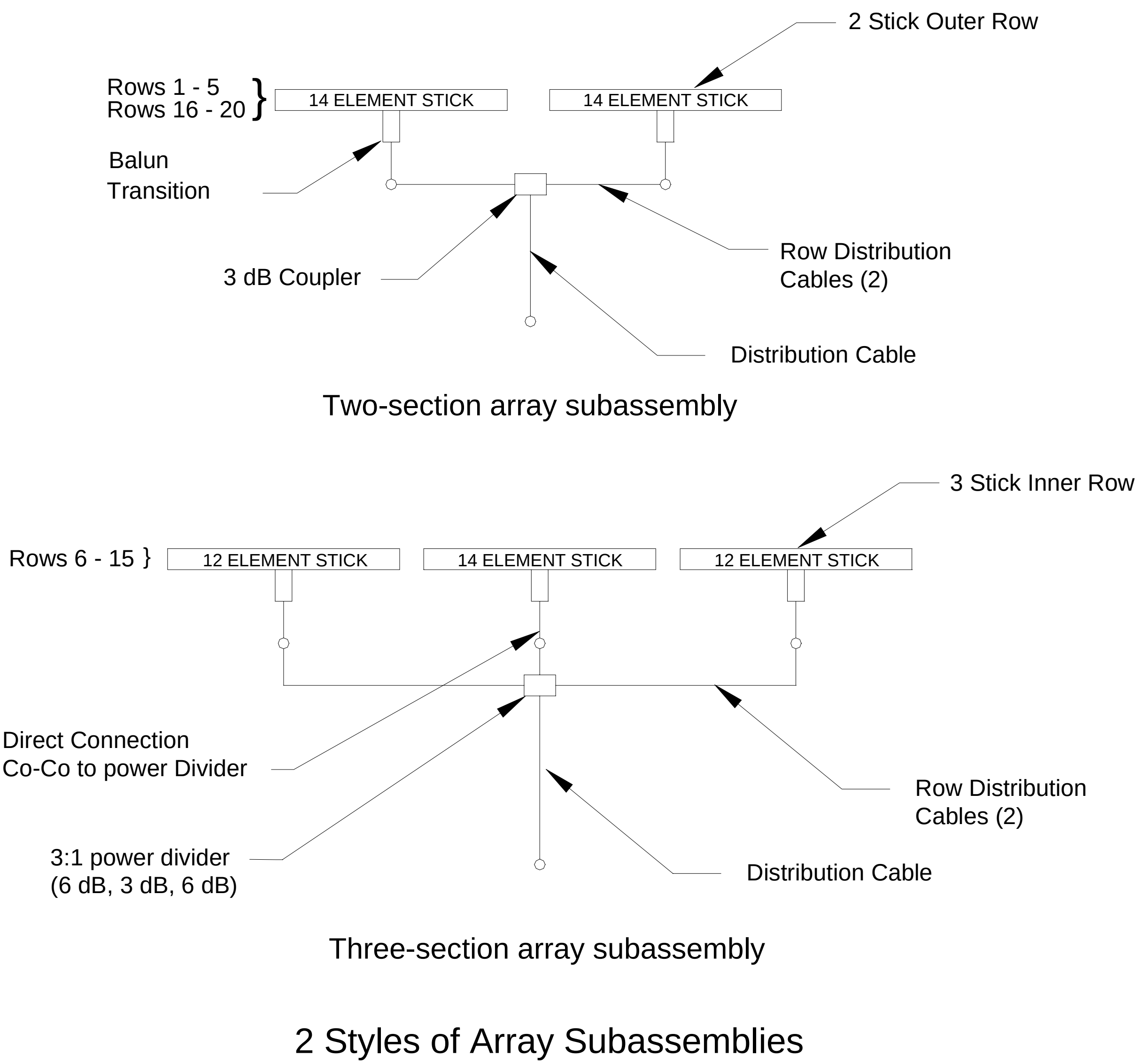


Figure 7-3 Two Styles of Coaxial Array Subassemblies

The complete antenna array assembly layout is shown in Figure 7-4 illustrating the orthogonal orientation and row numbering system of both arrays. Figure 7-5 shows the east array elements and its power divider locations. Figure 7-6 shows the north/vertical array elements and its power divider locations.

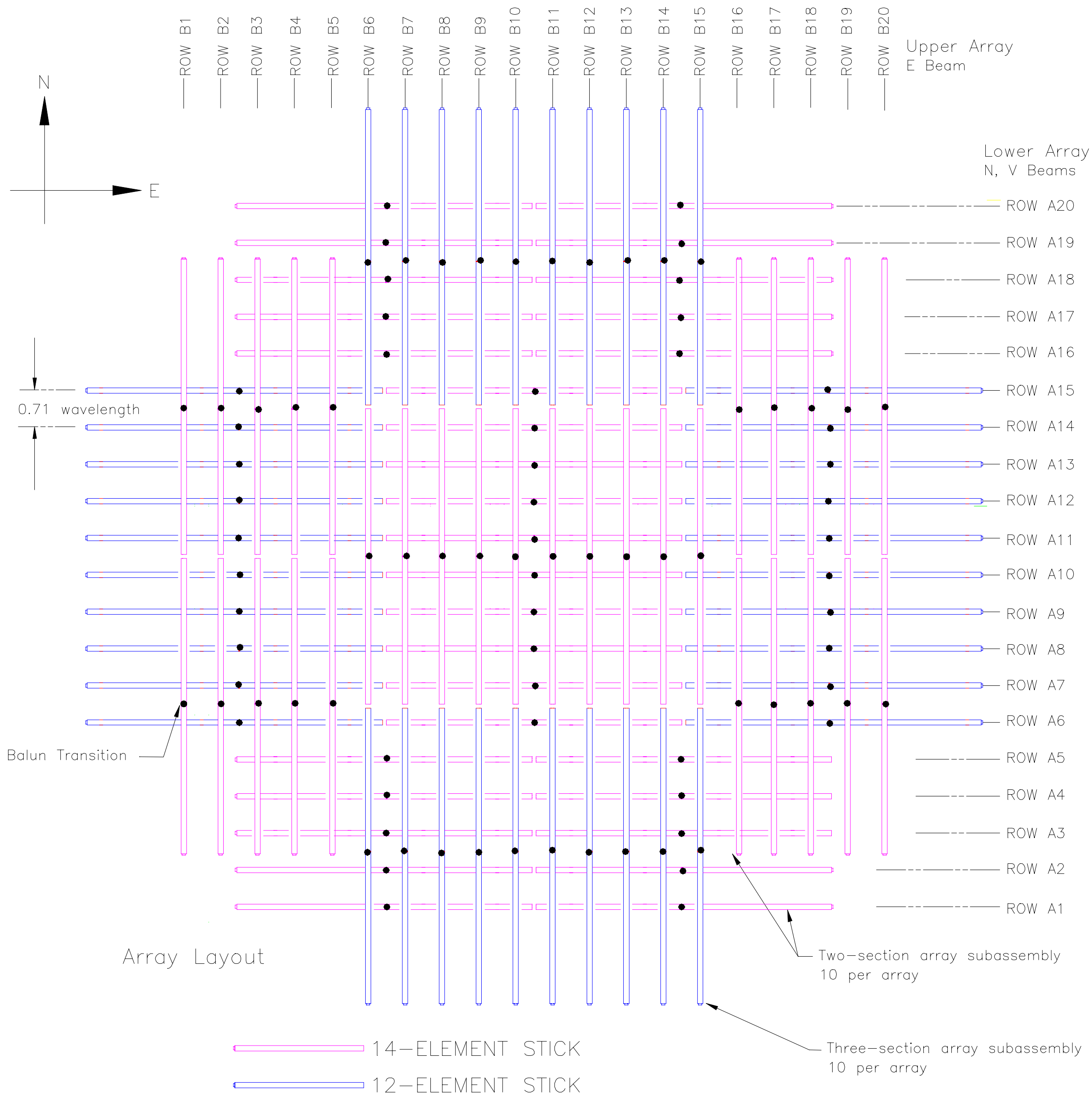


Figure 7-4 Complete Coaxial Antenna Array

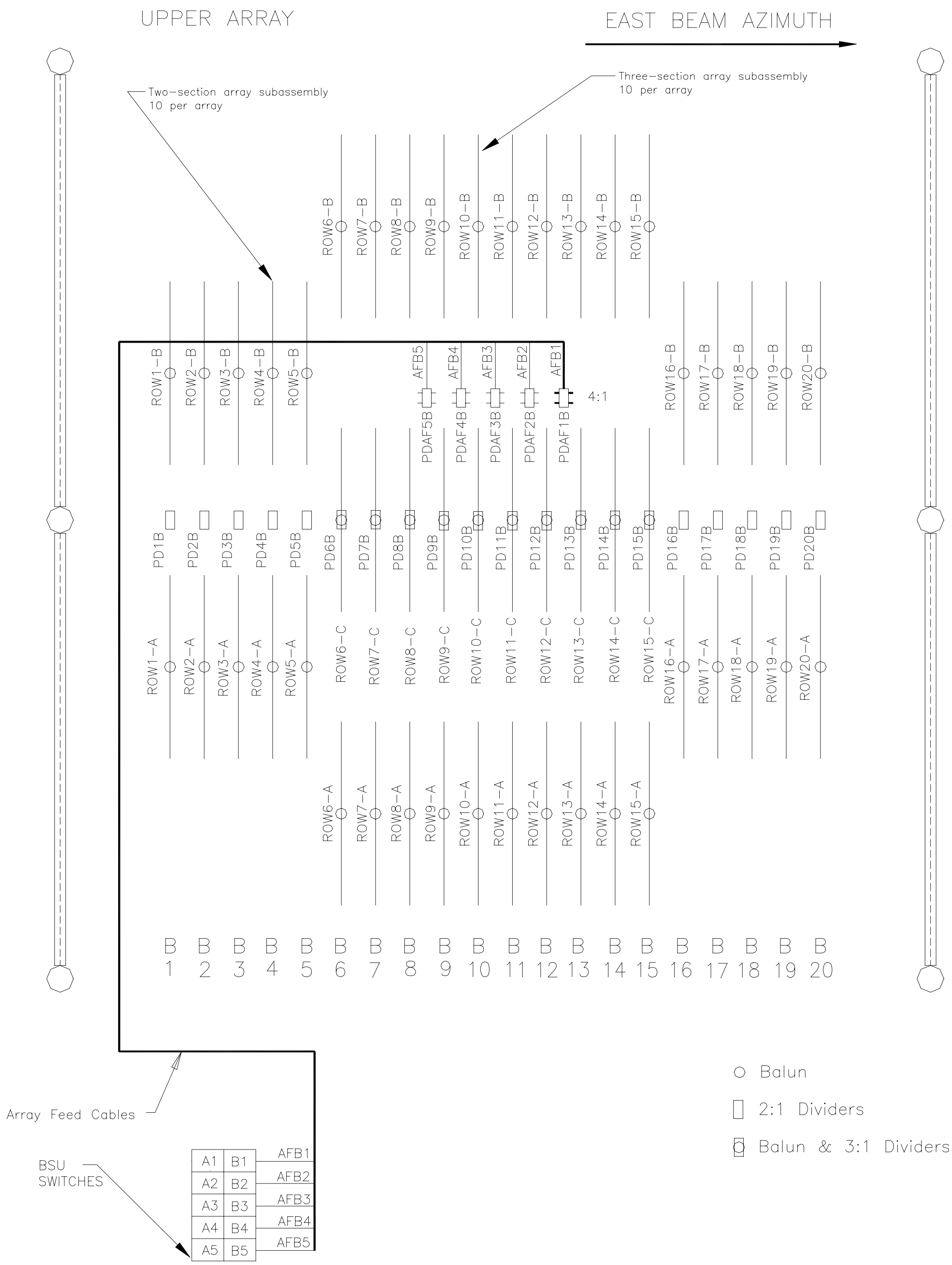


Figure 7-5 East Antenna Array (Upper Array)

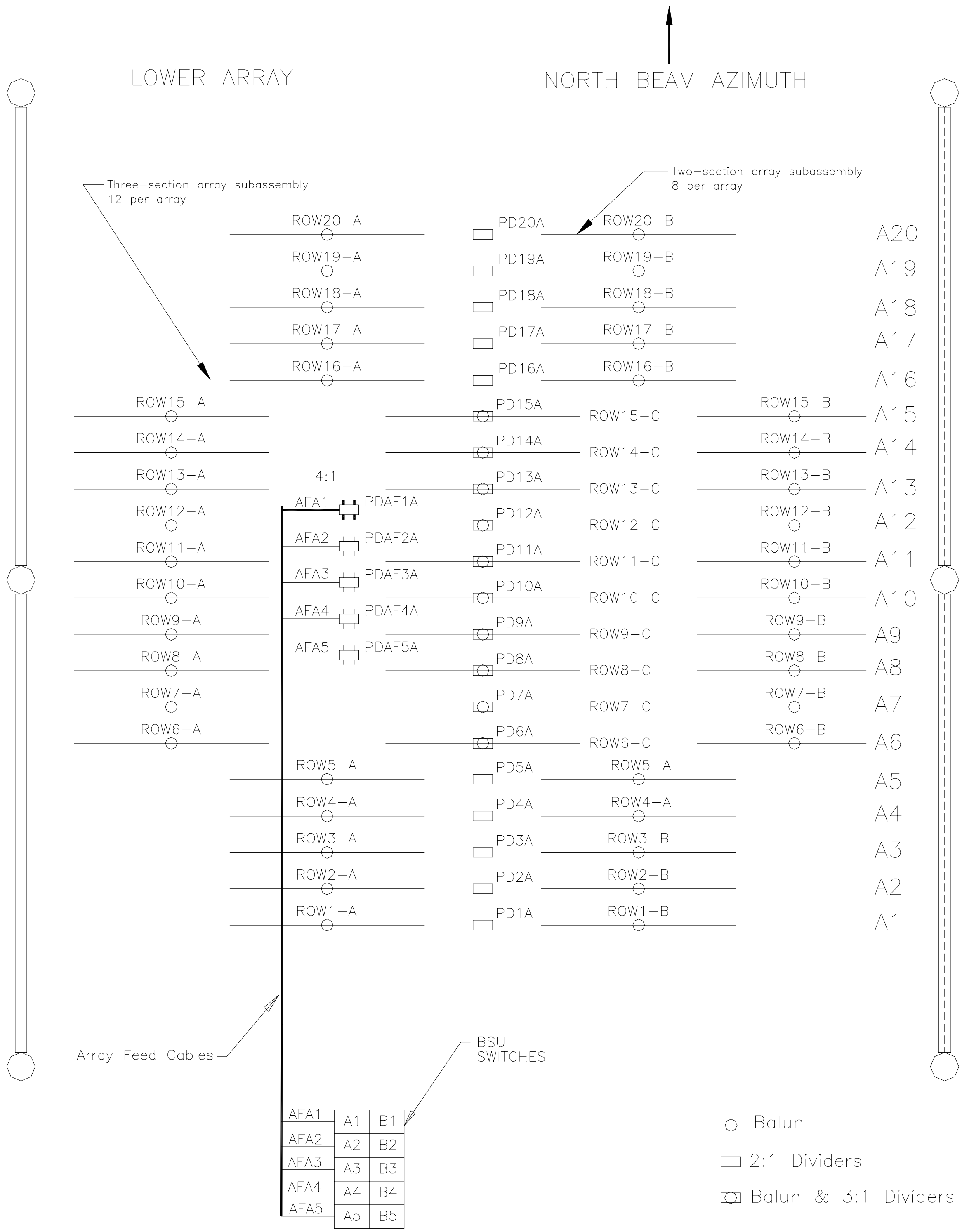


Figure 7-6 North/Vertical Antenna Array (Lower Array)

7.2 Power Dividers and Distribution Cables

The antenna power distribution network consists of various styles of power dividers including; one 5:1 power divider, ten 4:1 (3 types), twenty 3:1 power dividers, and twenty 2:1 power dividers. Distribution Feed Cables (of specific lengths) interconnect the power dividers and antenna elements.

7.2.1 5-Way Power Divider

This is a coaxial divider designed for operation at the design frequency. A reactive coaxial network design is employed to obtain minimum loss. The RF input is located at the top of the structure using a 1 5/8 inch EIA input connector (see Figure 5-2). The power split is obtained via a 1:5 impedance transformation that is implemented by proper selection of conductor diameters. The RF output among all five output ports are equal in both phase and amplitude. See Section 5.6 for more information about the 5-Way Power Divider.

7.2.2 4-Way Power Divider

The 4-way power divider is built using a similar design to a reactive version of the multiple port Wilkenson power splitter (see Figure 7-7). The space between the inner and outer conductors is dielectric loaded with teflon. Thus condensation of water vapor will not occur within the unit, eliminating the need for a separate protective housing. Typical insertion loss is less than 0.1 dB. Three styles of 4:1 power dividers are used, each having a different output port power distribution (port A,B,C,and D). Table 7-2 lists the power split percentage of the three styles of 4:1 power dividers used in the system.

Figure 7-7 4-Way Power Divider

Table 7-2 4:1 Power Divider Power Split Percentage

Output Port	Style 1* (%)	Style 2* (%)	Style 3**(%)
A	8.1	8.9	11.3
B	22.2	15.8	38.7
C	25.8	33.1	38.7
D	43.9	42.2	11.3

*2 per array
**1 per array

7.2.3 3-Way Power Divider

The 3-Way power split is obtained by 3 branch 3 Wavelength/4 coaxial transformer section with the inner conductor sizes set to obtain the required impedances. Standard type "N" connectors are used on both inputs and outputs.

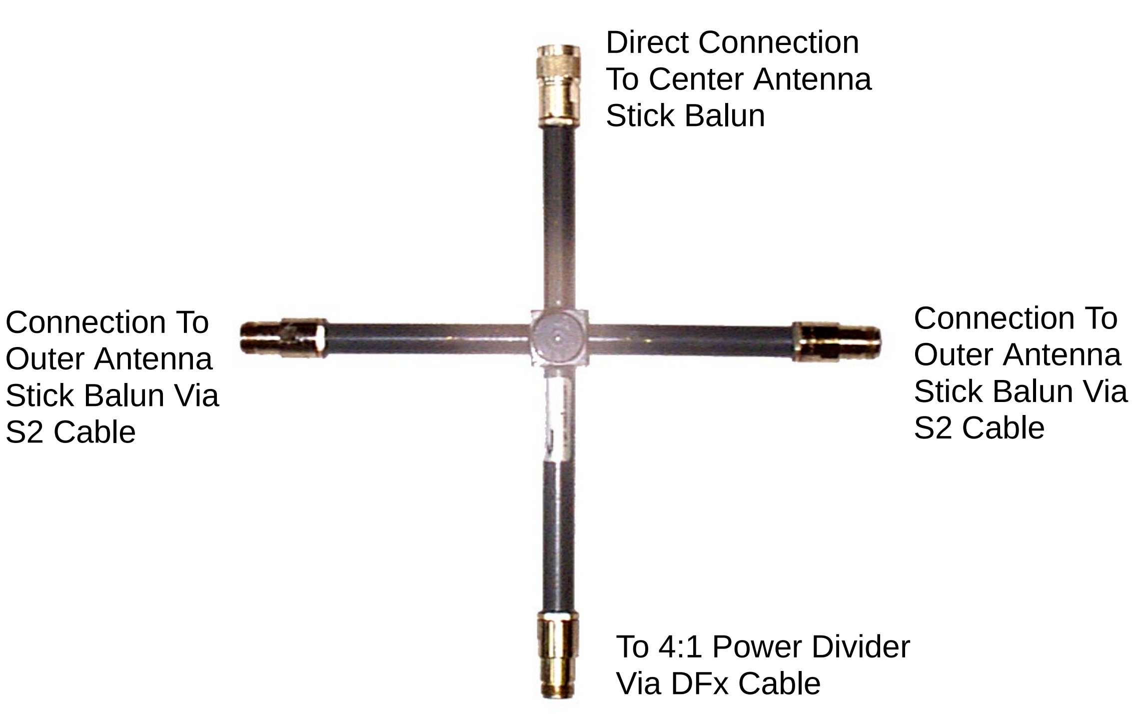


Figure 7-8 3-Way Power Divider

7.2.4 2-Way Power Divider

The 2-Way power divider is a simple reactive tee with a built-in matching coaxial transformer tuned to the operating frequency. Standard type "N" connectors are used on both input and outputs.

Figure 7-9 2-Way Power Divider

7.2.5 Distribution Feed Cables

Ten Antenna Feed (AF) Cables connect the ten 4-way power dividers to the Beam Steering Unit (BSU). All ten antenna feed cables are 7/8-inch diameter, low loss, foam-filled, equal length (35 feet), and phase matched to < 3 degrees.

Distribution Feed (DF) cables are then used to interconnect the 4:1 power dividers with 3:1 and 2:1 power divider assemblies. A total of six different DF cable lengths are used in the antenna array (refer to Table 7-3).

S1 cables are used to connect two-element subarray antenna sticks to 2:1 power divider assemblies. S2 cables are used to connect three-element subarray sticks (the two outer antenna sticks) to 3:1 power divider assemblies.

Figure 7-10 shows the complete antenna interconnection diagram for the East Beam array (Array #2). Figure 7-11 shows the complete antenna interconnection diagram for the North/Vertical Beam array (Array #1). It is vital that all connections be made exactly as shown to ensure that the antenna system has the required illumination function resulting in the desired radiation pattern.

Table 7-3 Distribution Feed (DF) Cables

Cable ID	Physical Length (ft.)	Electrical Wavelength	Qty. East Array	Qty. N/V Array	Qty. per System
AF	35.0	--	5	5	10
DF2	4.32	x2	2	5	7
DF3	6.49	x3	5	3	8
DF4	8.64	x4	3	3	6
DF5	10.82	x5	1	7	8
DF6	12.96	x6	6	2	8
DF7	12.15	x7	3	0	3
S1		--	20	20	40
S2		--	20	20	40

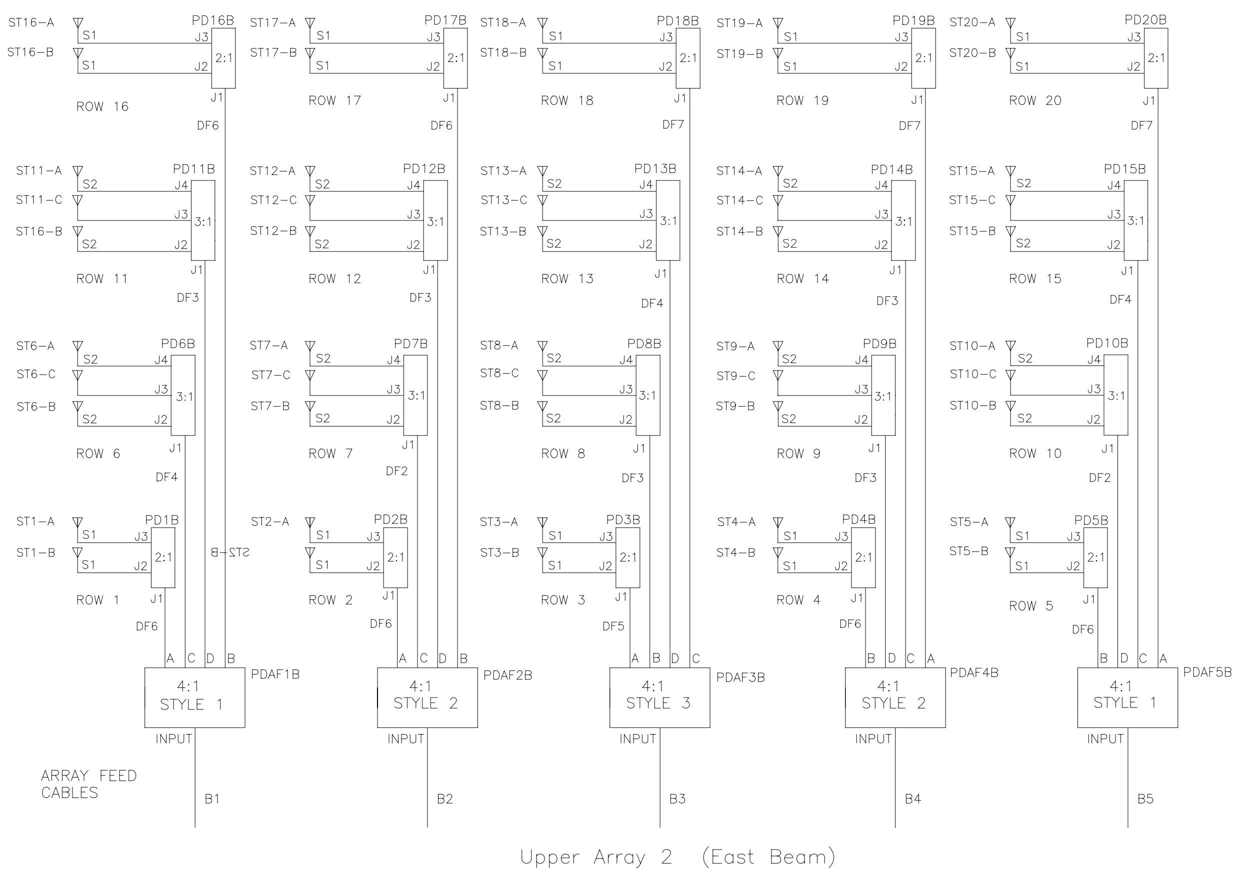


Figure 7-10 East Beam Antenna Array Cabling Diagram

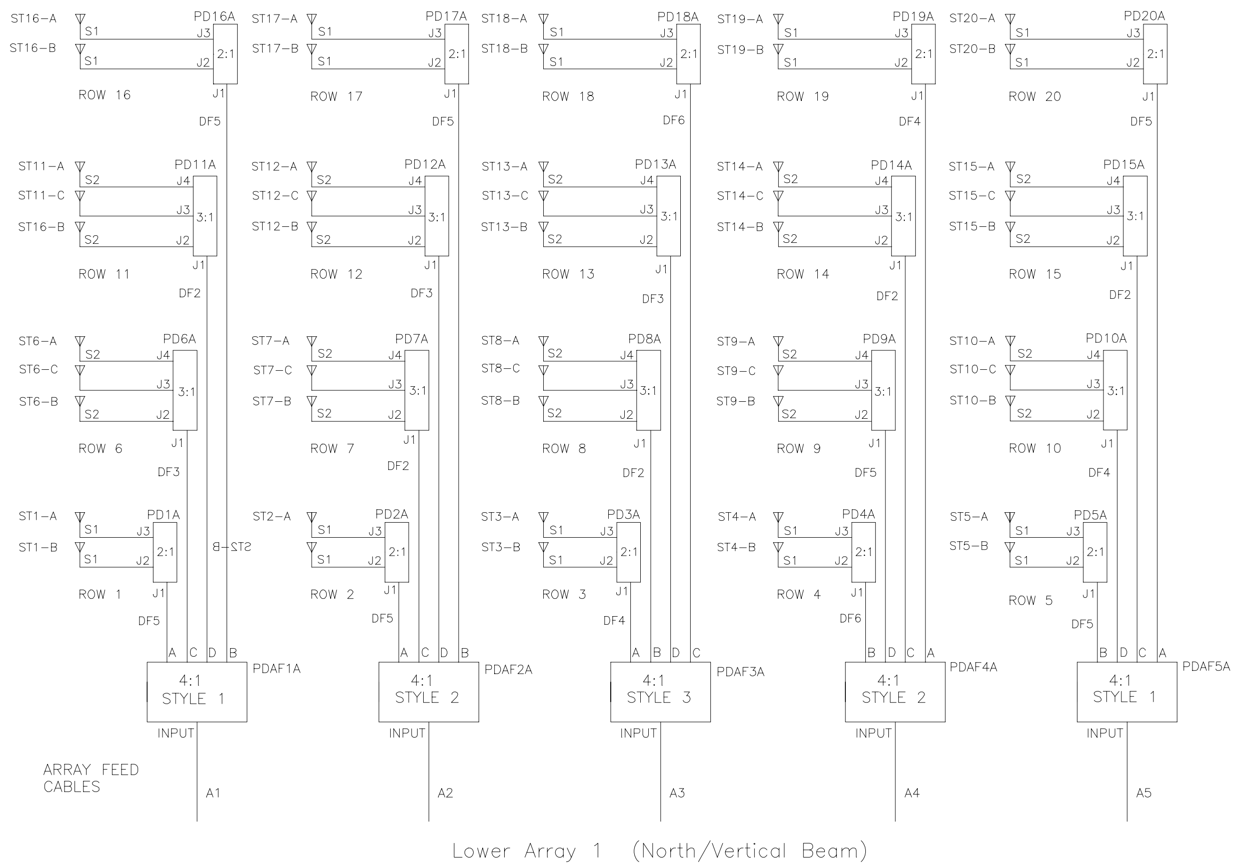


Figure 7-11 North/Vertical Beam Antenna Array Cabling Diagram

7.3 Beam Steering Unit

The Beam Steering Unit (BSU) switches RF power between the two antenna arrays and routes RF power through phase delay cables to steer the antenna beam in the desired direction and angle. For more Information about the BSU, see Section 5.8.

7.4 Antenna Feed Cable Return Loss Test

VSWR (Voltage Standing Wave Ratio) faults will cause the radar to shut down. VSWR faults can be caused by BSU switch failures, but can also be caused by antenna failures. Antennae failures can be identified by using a meter to measure the return loss at each of the ten antenna feed cables. If a problem with the antenna is identified, the problem can be reported to the Profiler Control Center (PCC). The PCC will arrange to have the antenna repaired by the Profiler Ranger Team. The following procedure can be used to test and identify faulty antennas.

1. **Turn off the AC power for the Power Amplifier Cabinet** at the breaker panel (breaker #17/19).

2. Remove the side panel from the BSU cabinet.

3. Disconnect the ten extension cables (W111) from the output ports (*ARRAY 1* and *ARRAY 2*) from each of the BSU switch assemblies.

4. Turn on Anritsu Site Master. Attach "N" type cable with "barrel" adopter on back of unit. Insure top of display is set for "RETURN LOSS" and at bottom of display marker 1 (M1) displays 0.00 at 404.37 MHz as shown in Figure 7-12.

   If *Anritsu* display is not correct, press *RECALL SETUP*, press 1, then press *ENTER*. The display should return to the correct settings.

5. Connect the Anritsu cable to the end of first antenna feed cable, wait for the Anritsu display cursor to sweep and record cable ID and meter reading as shown in Figure 7-13. Repeat this procedure for each of the ten antenna feed cables.

6. Return Cabinet to original condition. Make sure all cables are re-connected to their proper locations and tightened sufficiently.

7. A Return loss reading for the antenna feed cables >13db (less negative. 9,10,11) indicates Antenna problems. Call PCC for advice as to whether to continue operating Radar site.

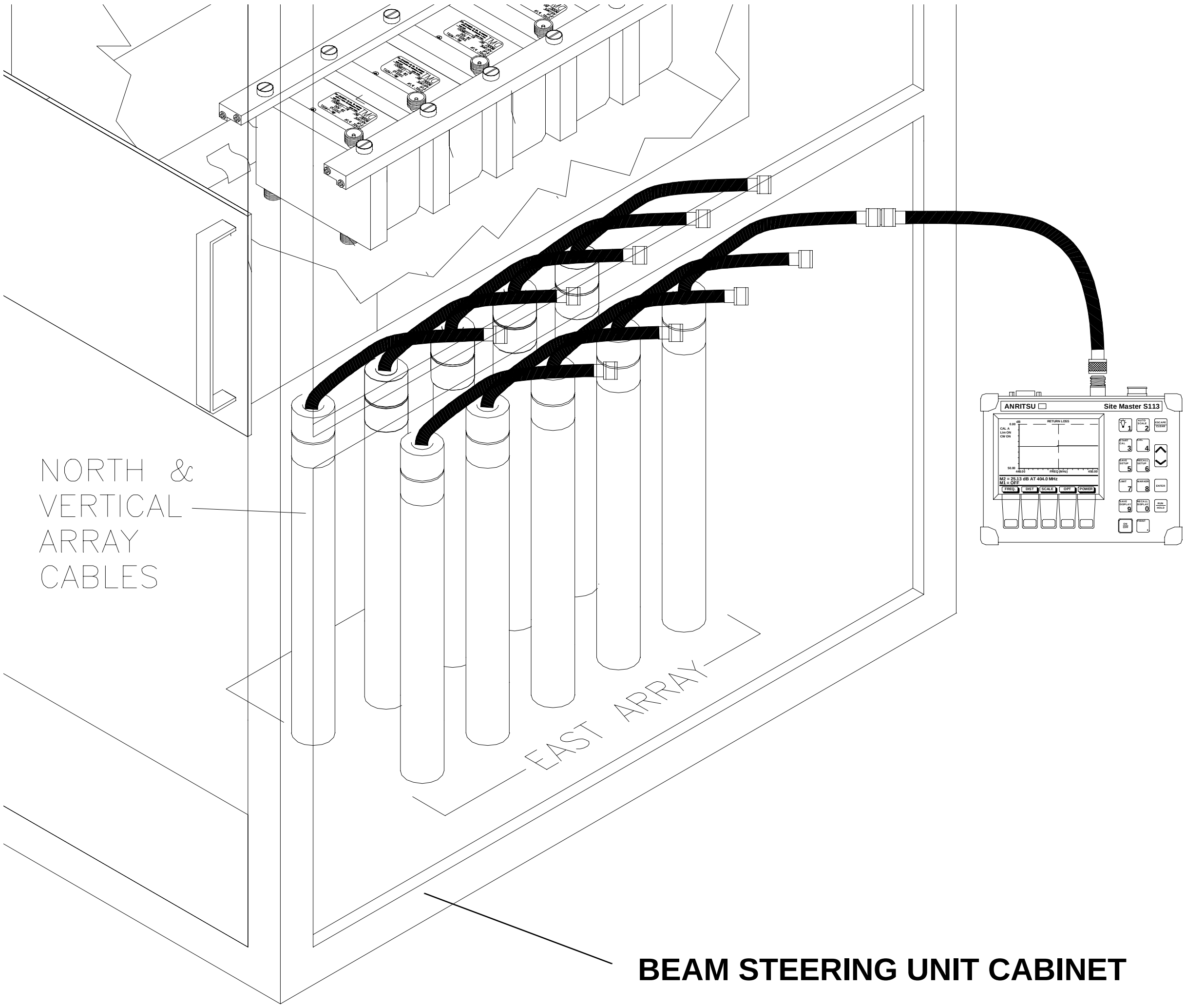


Figure 7-12 Antenna Feed Cable Return Loss Measurement

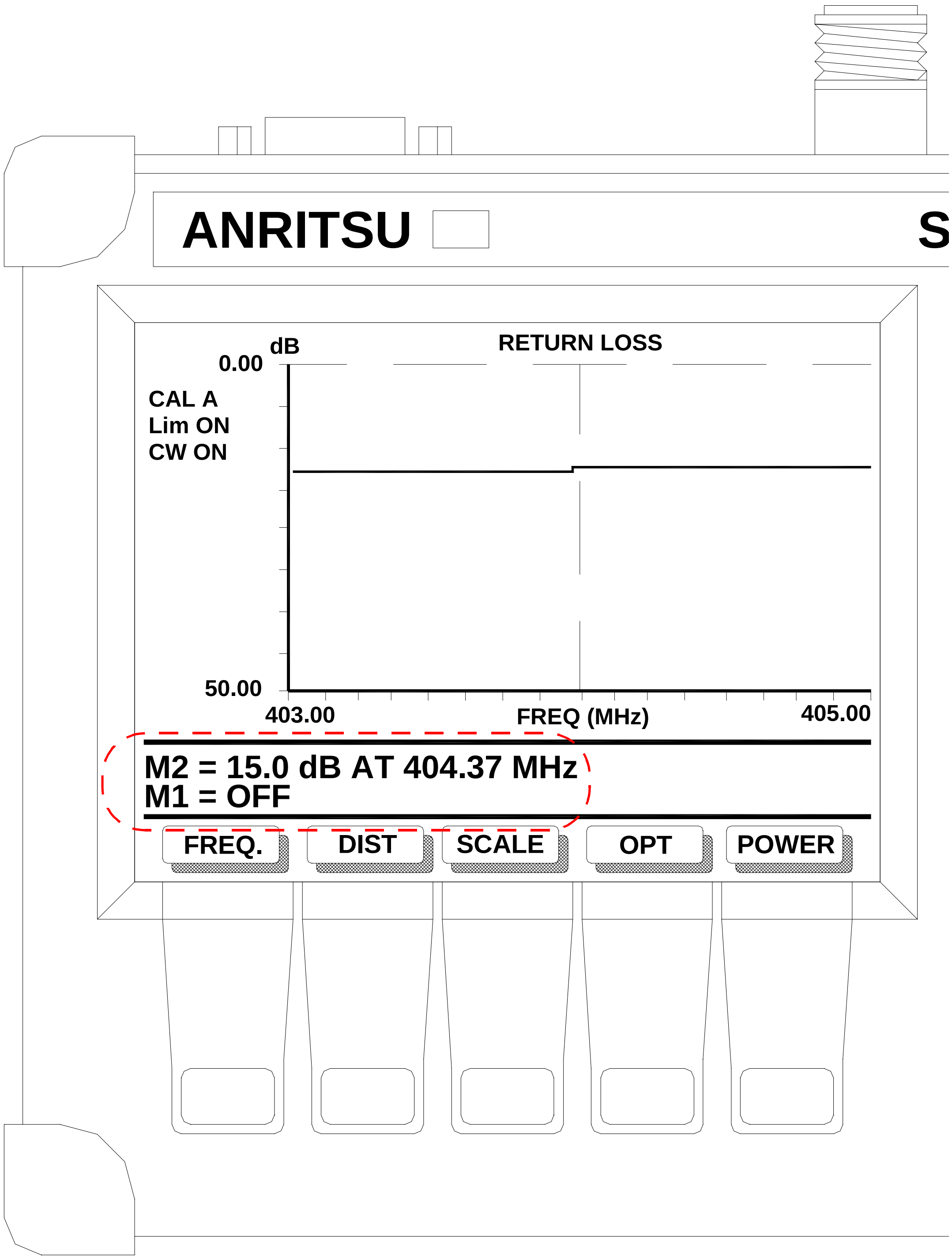


Figure 7-13 Anritsu Site Master Return Loss Display

8 Profiler Communications

In general, NOAA wind profilers have two independent communications systems; the *Landline communication link* and the *GOES communication link*. Figure 8-1 illustrates the flow of data between the profiler sites and the Profiler Control Center (PCC) over these links.

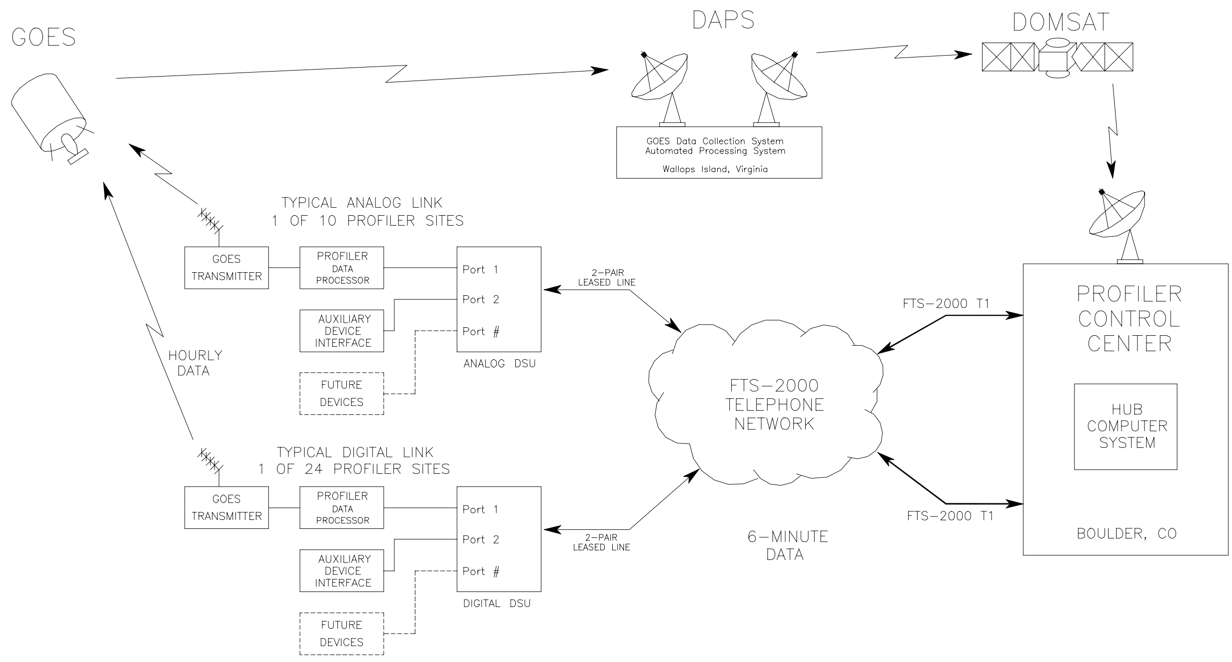


Figure 8-1 Profiler Network Data Flow

8.1 Landline Communications System

The Landline Communication System (or Landline link) provides two-way communications between the profilers and the Hub. The profilers send wind data and status information to the Hub at 6-minute intervals, and the Hub uses this link to transmit commands and SARSAT turnoff schedules to the profiler.

The Landline links are comprised of FTS-2000 leased lines which are multiplexed onto several T1 lines to Boulder, CO. As illustrated in Figure 8-1, radar data are transmitted from the profilers to the Hub using a Data Service Unit (DSU). The DSU at the profiler site is located in the Equipment Cabinet above the RF Generator (see Figure 4-1).

A DSU is a multi-channel modem that uses Time Division Multiplexing (TDM) to provide multiple, independent, RS-232 ports capable of interfacing with any device that supports RS-232 serial communications. One of two versions of the DSUs are used at profiler sites (depending on the capabilities of the local phone company). The first version, a digital DSU, is used at the majority of profiler sites. The second version, an analog DSU, is used at sites where the local phone company does not support digital communications service.

The DSUs at the profiler sites are leased from, and maintained by AT&T Paradyne Services. Under some circumstances, El-Techs may be asked to power cycle the communications equipment breaker, but in general, NWS technicians are not responsible for maintenance of this equipment and should avoid disrupting the AC power to this system unless it is absolutely necessary.

There are minor physical and functional differences between digital and analog DSUs. Section 8.1.1 and Section 8.1.2 provide greater detail about the AT&T Paradyne model 3610 digital DSU, and the model 3920 analog DSU.

8.1.1 Model 3610 Digital Data Service Unit (DSU)

The AT&T Paradyne model 3610 DSU is a stand-alone digital version of the Comsphere 3000 series modems. The 3610 DSU has an integral Time Division Multiplexer (TDM) that provides multiplexing of six independent RS-232 ports on a single leased line (point-to-point) circuit. The aggregate leased line operates at 9600 baud and utilizes V.32t and V.32bis for modulation control. Each of the DSU's six ports have user-configurable settings for baud rate, data bits, stop bits, and parity. All six ports can be utilized providing that the sum of baud rates for all utilized ports does not exceed 9600 baud.

The front panel of the 3610 DSU provides status indicator LEDs and a two-line alphanumeric display that can be used to examine or modify configuration parameters (refer to Figure 8-2). The display is menu-driven and is manipulated using the arrow and function keys on the front panel.

The rear panel of the 3610 DSU provides six DB-25 female connectors (labeled EIA Port 1 - Port 6) to interface with RS-232 devices. The power supply for the DSU is external to the unit and plugs into the circular jack labeled POWER. The phone cable plugs into the type RJ-8 phone jack labeled LINE (refer to Figure 8-3).

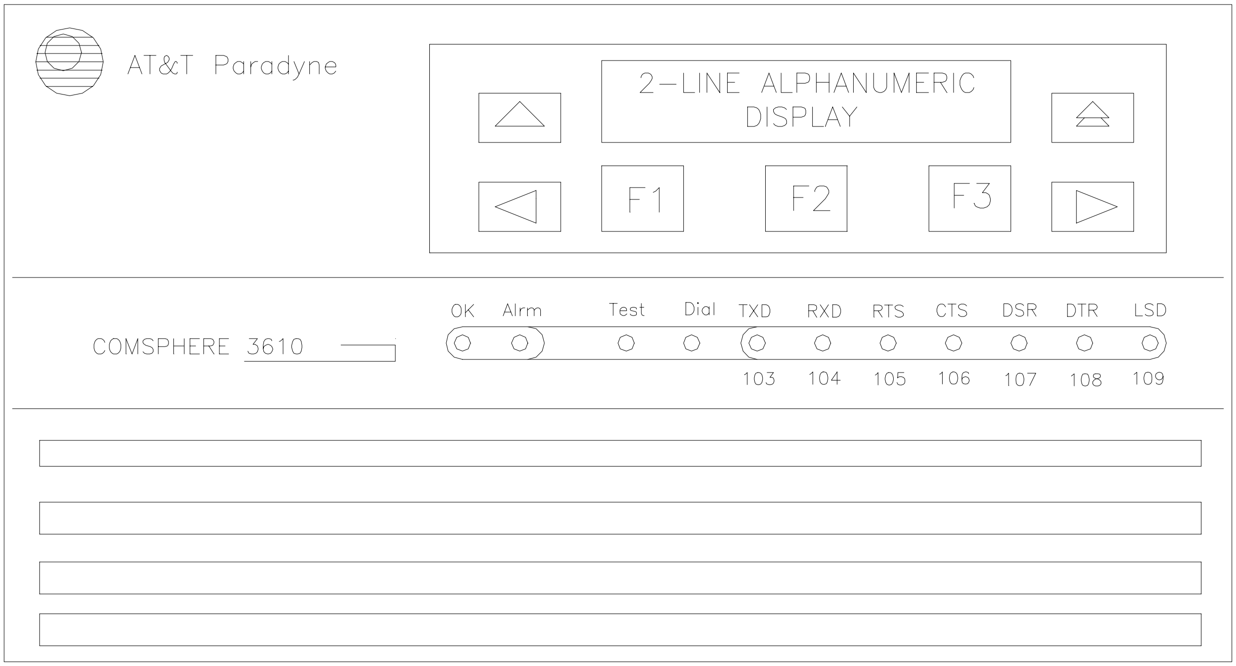


Figure 8-2 Model 3610 Data Service Unit Front Panel

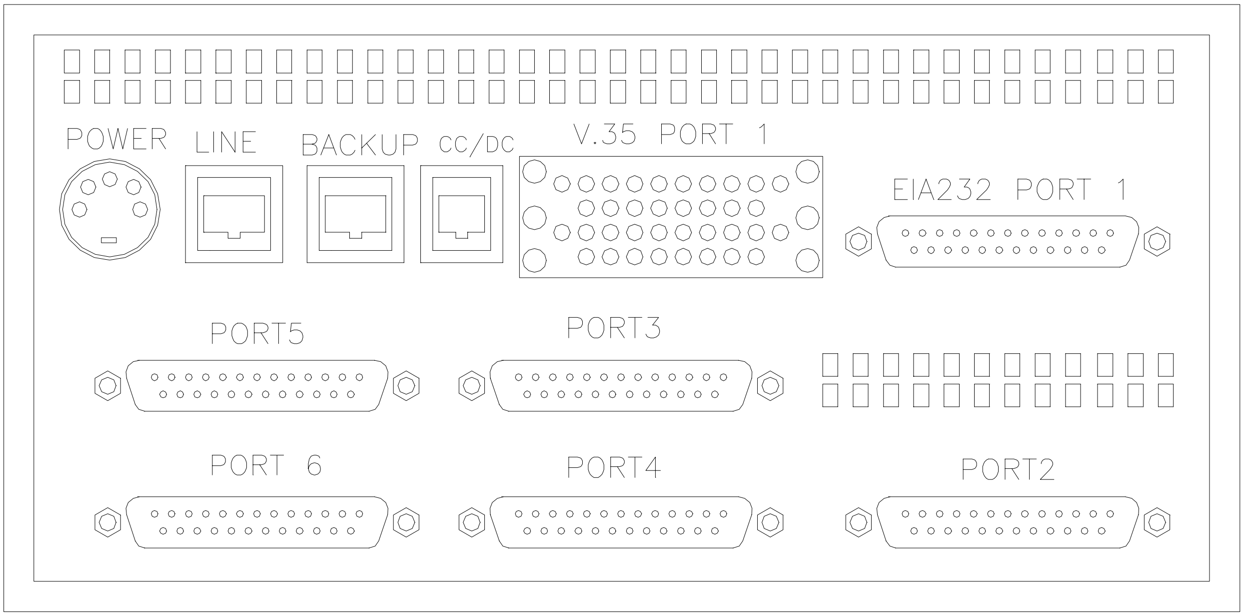


Figure 8-3 Model 3610 Data Service Unit Rear Panel

At some profiler site locations, if the line signal quality is poor, the local phone company may choose to install a Digital Data Station Termination module (DDST). The DDST enables phone company technicians to fine-tune the transmit and receive levels of the leased line. The DDST is property of the local phone company, and NWS technicians have no responsibility for maintaining this piece of equipment. The DDST (if installed) is located in the Equipment Cabinet next to the DSU (refer to Figure 4-1). For reference purposes, a communications interconnection diagram for sites with digital DSUs is provided in Figure 8-4.

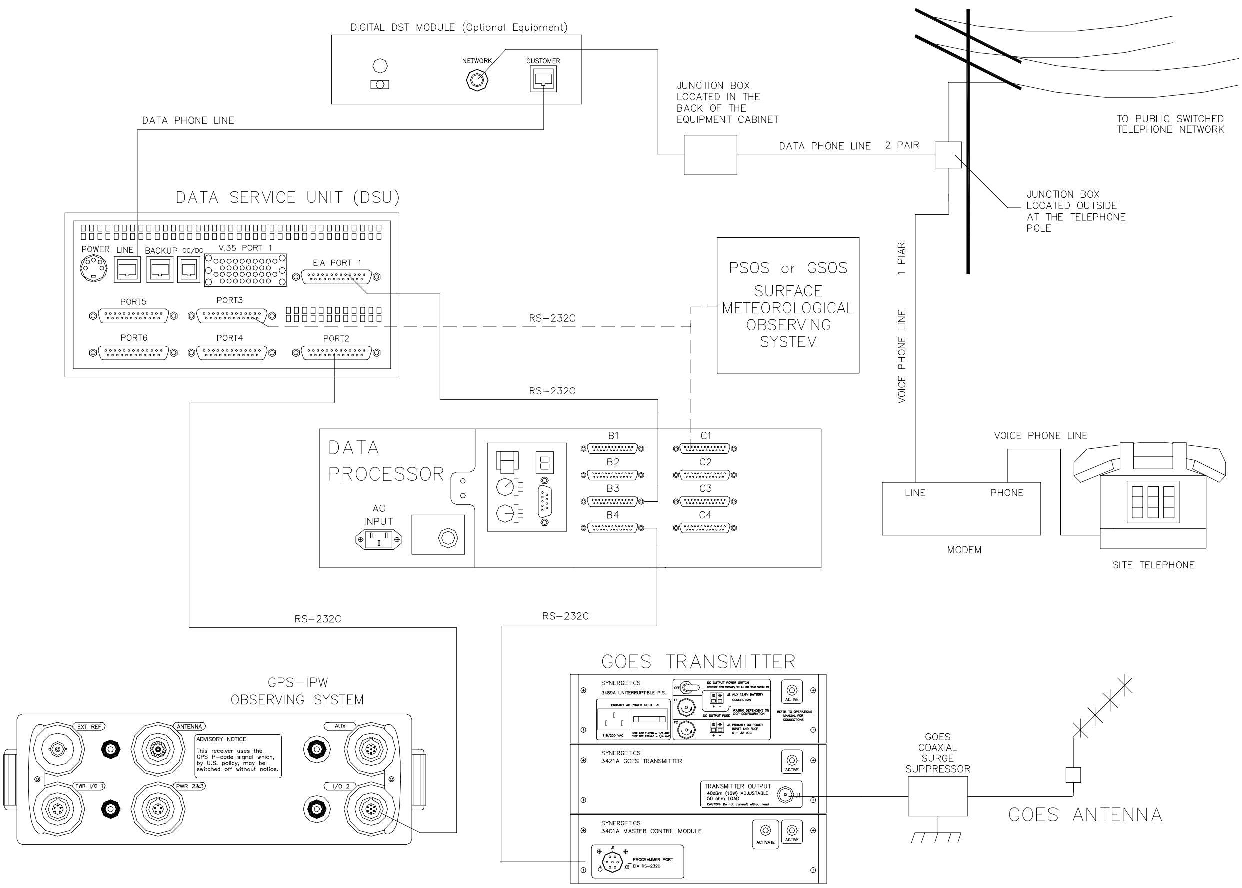


Figure 8-4 Communications System Interconnections Using a 3610 DSU

8.1.2 Model 3920 Analog Data Service Unit (DSU)

The AT&T Paradyne model 3920 DSU is a stand-alone analog version of the Comsphere 3000 series modems. The 3920 DSU has an integral Time Division Multiplexer (TDM) that provides time division multiplexing of four independent RS-232 ports on a single leased line (point-to-point) circuit. The aggregate leased line operates at 9600 baud and utilizes V.32t and V.32bis for modulation control. Each of the DSU's four ports have user-configurable settings for baud rate, data bits, stop bits, and parity. All four ports can be utilized providing that the sum of baud rates for all utilized ports does not exceed 9600 baud.

The front panel of the 3920 DSU provides status indicator LEDs and a two-line alphanumeric display that can be used to examine or modify configuration parameters (refer to Figure 8-5). The display is menu-driven and is manipulated using the arrow and function keys on the front panel.

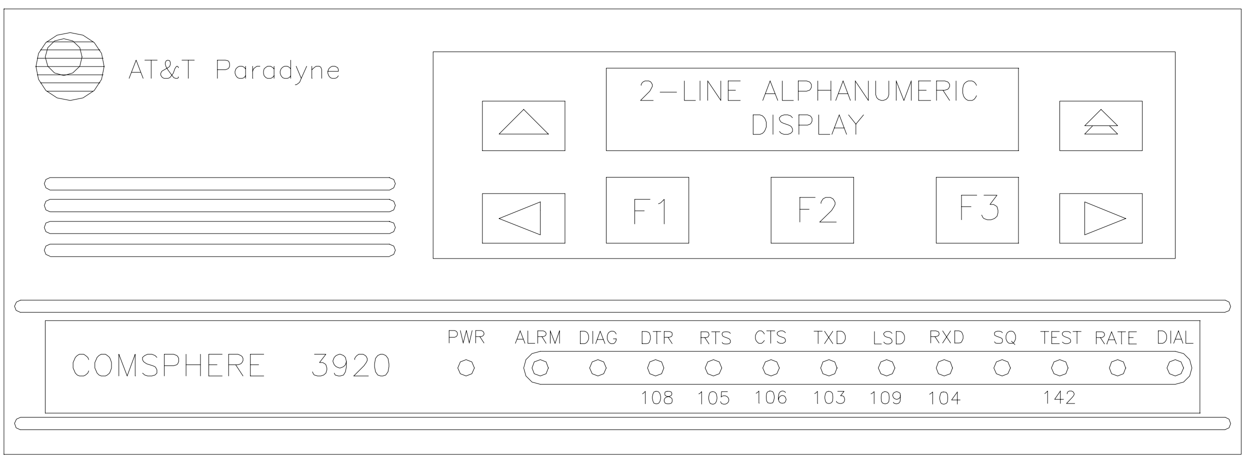


Figure 8-5 Model 3920 Data Service Unit Front Panel

The rear panel of the 3920 DSU provides four DB-25 female connectors (labeled DTE 1 - DTE 4) to interface with RS-232 devices. The power supply for the DSU is external to the unit and plugs into the circular jack labeled PWR. The phone cable plugs into the type RJ-8 phone jack labeled LEASED (refer to Figure 8-6)

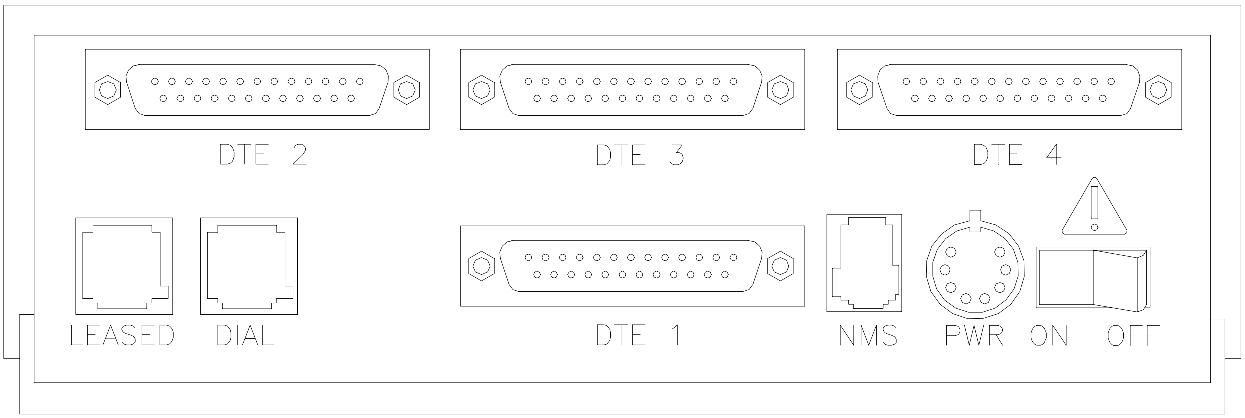


Figure 8-6 Model 3920 Data Service Unit Rear Panel

Profiler sites using analog DSUs require an additional piece of equipment at the site to terminate the analog leased-line. This device is referred to as a Data Station Termination Module (DST). The DST is provided, owned, and maintained by the local telephone company in the area where the profiler is located. The DST is used to adjust the gain and attenuation in the transmit and receive channels of the leased line, as well as provide optimum amplitude equalization on the transmit channel. Any adjustments or modifications of the DST should be done only by the local phone company.

The DST is located above the RF Generator in the Equipment Cabinet (refer to Figure 4-1). For reference purposes, a communications interconnection diagram for sites with analog DSUs is provided in Figure 8-7.

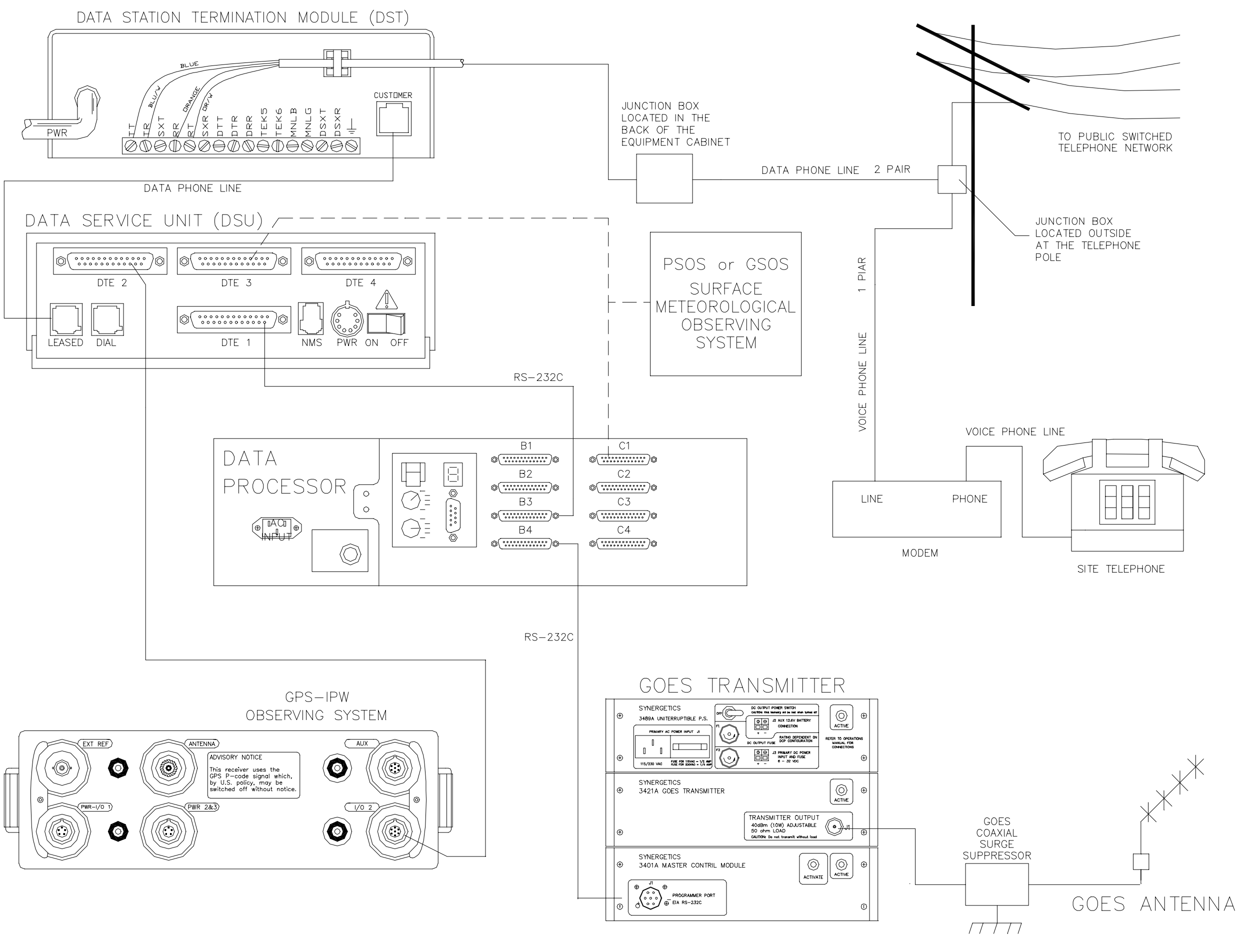


Figure 8-7 Communications System Interconnections Using a 3920 DSU

8.2 GOES Communications System

The profiler Data Processor calculates hourly winds by averaging the previous hours 6-minute data samples. The hourly wind data, select 6-minute data, and status data are transmitted to the PCC Hub using the GOES Communications System (or GOES link). A profiler GOES data transmission is allocated 1 minute per hour, and depending on the site configuration, will transmit between minute 1 and minute 18 of the hour. The path of hourly GOES data from the profiler site to the PCC is illustrated in Figure 8-1.

The GOES Communications System consists of a GOES Assembly and a Crossed Yagi antenna. The GOES Assembly is located inside the shelter below the breaker panel in a white NEMA enclosure. As illustrated in Figure 8-8, the GOES Assembly consists of four components: the 3489A Uninterruptible Power Supply, the 3421A GOES Transmitter, the 3401A Master Control Module (MCM), and a coaxial surge suppressor. These components are described in the following paragraphs.

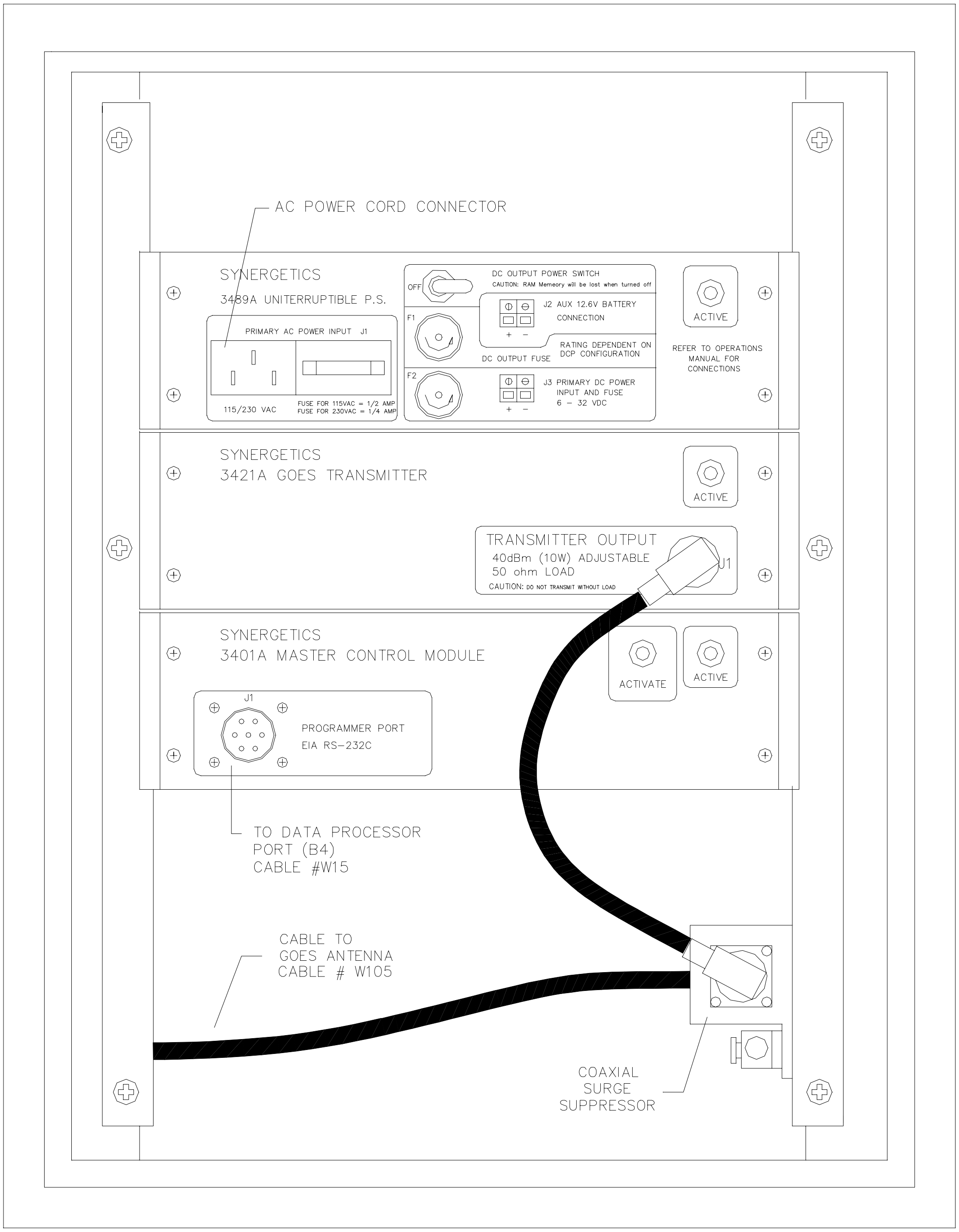


Figure 8-8 GOES Assembly Front Panel

3489A Uninterruptible Power Supply

The Synergetics Model 3489A Uninterruptible Power Source (UPS) provides the MCM and GOES Transmitter with uninterrupted 12 VDC power and provides a trickle charge to a battery within the UPS. Power to the GOES Assembly is shut off by turning the locking toggle switch on the front panel of the UPS to OFF.

The ACTIVE LED on the front panel of the UPS indicates the amount of current being drawn from the UPS charging circuit. Intermittent blinking of the ACTIVE LED indicates the internal battery is being trickle-charged. Constant illumination of the ACTIVE LED indicates that greater amounts of current are being drawn.

3421A GOES Transmitter

The Synergetics Model 3421A GOES Transmitter is a 10-Watt frequency-agile UHF transmitter designed to relay digitally encoded data to any one of several operational geosynchronous satellites managed by the United States, Japan, or the European Space Agency. The GOES Transmitter receives data from the MCM through an interface called the S-34 bus, and transmits these data to a GOES satellite at a rate of 100 baud. When the unit is transmitting, the ACTIVE LED on the front panels of the GOES Transmitter is illuminated. The GOES Transmitter is equipped with an exceptionally stable oscillator (the GOES Clock) used by the Data Processor as the profiler system time reference.

3401A Master Control Module

The Synergetics 3401A Master Control Module (MCM) is the brain of the GOES Assembly. The MCM utilizes a 6802 microprocessor and runs the SAT-SOFT firmware developed by Synergetics. SAT-SOFT enables the profiler Data Processor to down load specific operating parameters to the MCM, and transfer profiler data to the MCM for hourly GOES transmissions.

The connection between the Data Processor and the MCM is a standard 1200- baud RS-232 interface. To communicate with the MCM, the Data Processor must assert the Data Terminal Ready (DTR) signal to wake the MCM from a sleep mode. When the MCM is awakened, the ACTIVE LED in the front panel of the MCM illuminates. The front panel of the MCM has a push button labeled ACTIVATE. This button can be used to manually awaken the MCM from sleep mode.

Coaxial Surge Suppressor

The PolyPhaser IS-50NX-C2 coaxial surge suppressor prevents transient voltage spikes caused by lightning strikes from entering the system through the GOES antenna.

8.2.1 GOES Assembly Replacement

1. Open the access door on the front of the GOES enclosure.

2. Turn off the *DC OUTPUT POWER* switch on the front panel of the 3489A Uninterruptible Power Supply and remove the AC power cord from the front panel of the unit (see Figure 8-8).

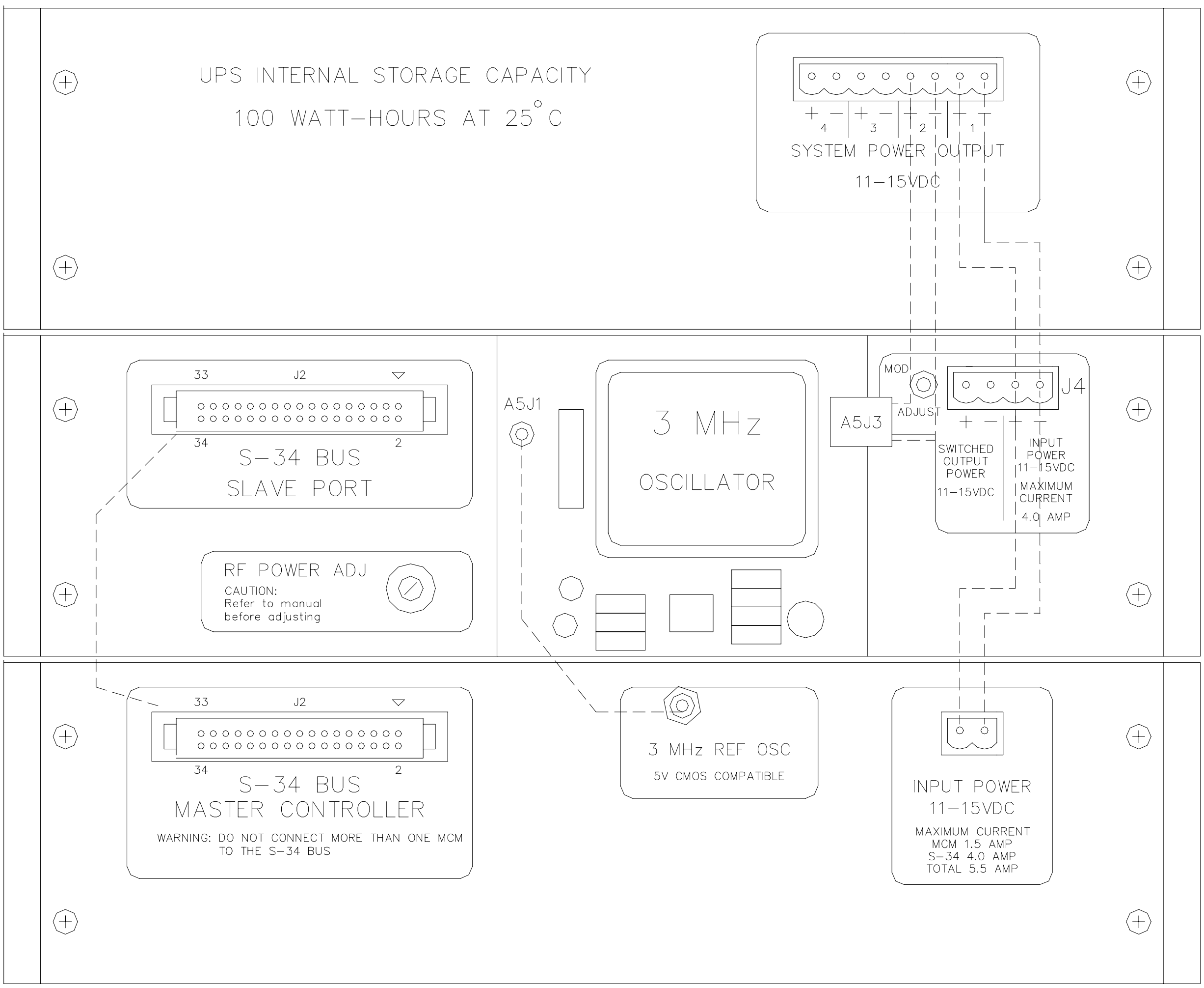


Figure 8-9 GOES Assembly Rear Panel Interconnections

3. Disconnect the coaxial cable from port J1 (transmitter output) on the front panel of the 3421A GOES Transmitter.

4. Disconnect the antenna cable from the coaxial surge suppressor.

5. Disconnect the communications cable from port J1 on the front panel of the 3401A Master Control Module.

6. Remove the braided ground cable from the coaxial surge suppressor lug.

7. Remove the mounting screws from the face of the rack angles of the GOES Assembly and remove the entire assembly from the cabinet.

8. Remove the rack angles from the GOES Assembly and transfer them to the new GOES Assembly.

9. Inspect the rear panel of the new GOES Assembly to verify that all cable connectors identified in Figure 8-9 are tight and properly connected.

10. Mount the new assembly in the NEMA cabinet and fasten the rack angles with the mounting screws.

11. Connect the braided ground cable to the lug of the coaxial surge suppressor and tighten the lug securely (refer to Figure 8-11).

12. Reconnect the AC power cable to the front panel of the UPS.

13. Reconnect the antenna cable to the coaxial surge suppressor.

14. Reconnect the coaxial cable to connector J1 on the front panel of the GOES Transmitter.

15. Reconnect the communications cable to connector J1 on the front panel of the MCM.

16. Turn on the *DC OUTPUT POWER* on the front panel of the 3489A by turning the locking toggle switch of the UPS to *ON*.

17. Close the access door on the front of the GOES enclosure.

8.2.2 GOES Assembly Master Control Module Initialization

The 3489A UPS battery provides 12 VDC power to the GOES Assembly until the DC OUTPUT POWER SWITCH (on the UPS front panel) is switched to the *OFF* position. When the UPS power source is removed from the GOES Assembly, the Master Control Module loses the contents of its memory and must be re-initialized using the procedures described below.

1. Log onto the Data Processor using the Portable Maintenance Terminal (PMT). This may take 1 - 2 beam-cycles because the system time provided by the GOES Clock is not available to the Data Processor.

2. When you have logged on, put the profiler in MAINTENANCE MODE and set the system time from the PMT System Parameters Menu. To synchronize the system time clock with a precise time standard, call WWV at (303) 499-7111 or contact the PCC for assistance.

3. Once the system time has been set, perform a Re-time System Cycle (System Initialization) command from the PMT System Operations Menu. This forces the Data Processor to down-load operating parameters to the GOES Assembly and synchronize the Data Processor and MCM clocks.

4. Verify that the MCM has been initialized correctly by referring to the PMT GOES MCM Menu and determining that the GOES Date and Time, Battery Voltage, and Temperature parameters appear on the lower portion of the screen as illustrated in Figure 8-10.

   If these values do not appear on the screen, repeat the Re-time System Cycle command. Several attempts may be required before the MCM initializes correctly. If these attempts are unsuccessful, contact the PCC for assistance.

8.2.3 GOES Coaxial Surge Suppressor Replacement

As with any surge protection device, the GOES Coaxial Surge Suppressor can be damaged, or rendered ineffective by a lightning strike. Since there is no way to field-test the effectiveness of the GOES Coaxial Surge Suppressor, generally, when a GOES antenna is replaced, the surge suppressor is also replaced as a measure of precaution.

1. Open the access door on the front of the GOES enclosure.

2. Turn off the DC power switch on the front panel of the 3489A Uninterruptible Power Supply (see Figure 8-8).

```
4 WPS-234, PASSWORD REQUIRED                              Maintenance
5  [SIM] This could take 6 minutes
6 COMMAND EXECUTED
                     GOES MCM Menu


 Goes Id                        750126DA         00000000-FFFFFFFE Hex
 Channel Number                 093              001-199 Decimal
 Transmit Frequency             1                1..6
 Preamble Length                S                S[hort] or L[ong]

 . Goes Date and time           00/01/30 12:35:54 YY/MM/DD HH:MM:SS
 . Next Transmit time           13:02:03         HH:MM:SS
 . Temperature                  028              Degrees Celsius
 . Battery Voltage              137              Tenths of Volts
 . Min. Battery Voltage         122              Hundredths of Volts
    During Last Xmit
 . Forward and Reflected        4020             dBm
    Transmitted power





1 Prev   2       3       4       5        6Enter  7      8      9       0 Dos
```

Figure 8-10   PMT GOES Master Control Module (MCM) Menu

3. Remove the two coaxial cables from the coaxial surge suppressor.

4. Remove the #10-24 machine screw that secures the ground lug and surge protector to the rack rail (see Figure 8-11).

5. Place the #10-24 machine screw through the ground lug, brass shim, and new surge protector, and fasten it to the rack rail. Check to be sure that the *Equipment* port of the surge suppressor is facing forward as illustrated in Figure 8-11.

6. Reconnect the two coaxial cables to the surge protector.

7. Turn on the DC power switch on the front panel of the 3489A Uninterruptible Power Supply.

8. Close the access door on the front of the GOES enclosure.

9. Initialize the GOES Assembly Master Control Module as described in Section 8.2.2

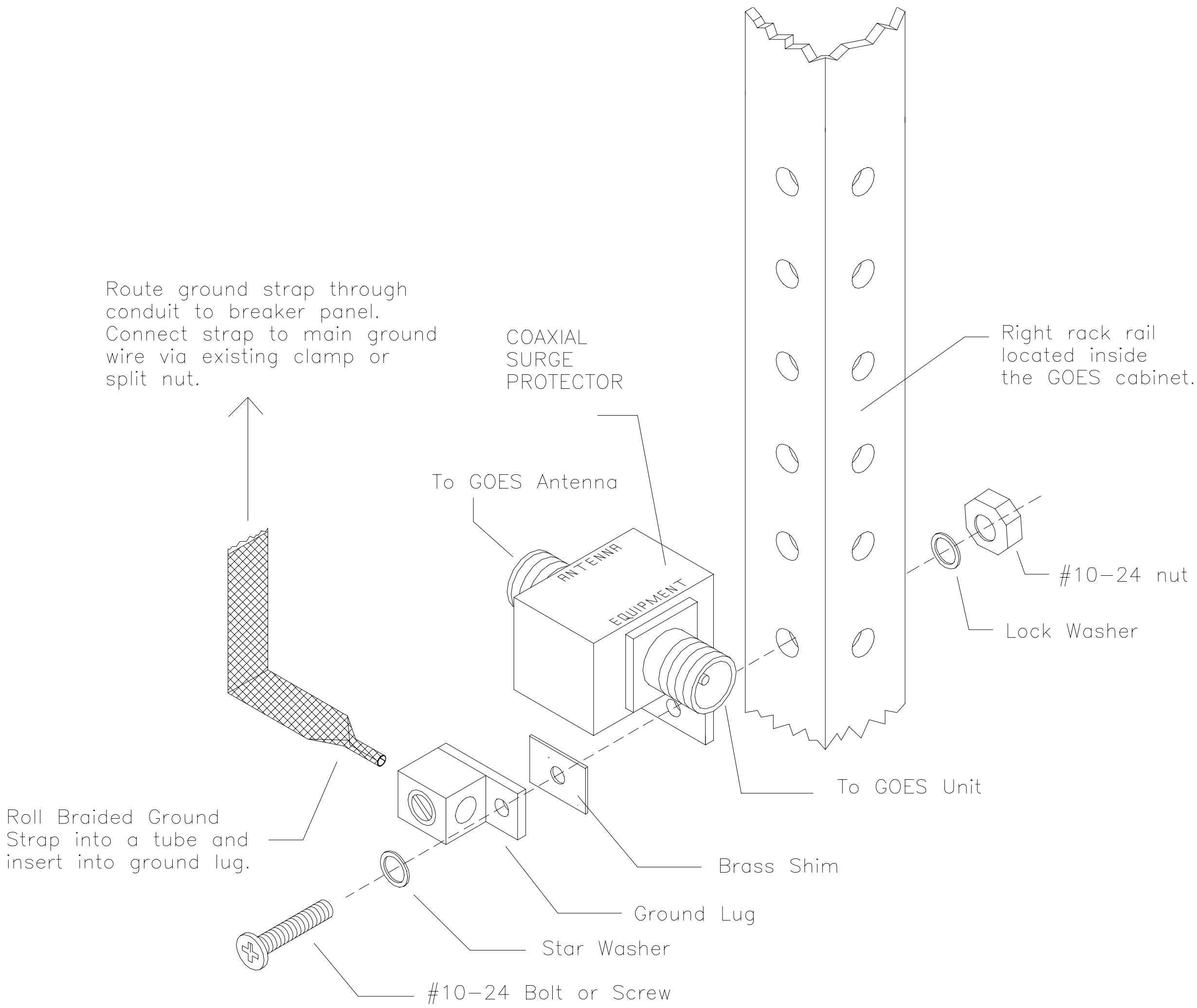


Figure 8-11 GOES Surge Suppressor Replacement

8.2.4 GOES Antenna Replacement

1. Open the access door on the front of the GOES enclosure.

2. Turn off the *DC OUTPUT POWER* switch on the front panel of the 3489A UPS (see Figure 8-8).

3. Carefully cut away the sealing tape covering the type N connectors just directly below the Antenna on the Antenna Mast.

4. Disconnect the antenna cable at the type N connector.

5. Loosen the set screws on the antenna mast and pull the antenna free of the top of the mast.

6. Assemble the new antenna according to the instructions included with the unit.

7. Install the new antenna on the mast.

8. Connect the type N connector to the antenna cable. Seal the coaxial junction with self-vulcanizing rubber tape and then apply a layer of electrical tape. Coat the outside of the tape with UV silicone rubber or Scotch Coat.

9. Orient the new antenna in the correct direction using the following information on GOES Antenna pointing directions.

   Because the beam width for the Synergetics Model 18B Crossed Yagi antenna is 47^o, pointing inaccuracies of approximately 5^o degrees will have a negligible effect on signal strength. This degree of accuracy is easily attained using a hand-held compass or pocket transit.

   Refer to Table 8-1 for the GOES antenna pointing angles for NPN profiler sites, and (if available) use a compass or pocket transit to measure all azimuths and elevations. (If there is no means to measure antenna elevation, an alternate method would be to adjust the new antenna elevation to match the old antenna elevation.) Adjust the antenna to the specified azimuth and elevation and tighten the set screws.

10. Turn on the *DC OUTPUT POWER* switch on the front panel of the UPS.

11. Close the access door on the front of the GOES enclosure.

12. Initialize the GOES Assembly Master Control Module as described in Section 8.2.2

Table 8-1 Profiler Site GOES Antenna Orientation Parameters

Site Location	State	Magnetic Declination (Deg)	Site Elevation (Meters)	Site Orientation From True North (Deg)	GOES Antenna Elevation (Deg)	GOES Antenna Azimuth (Deg)
Aztec	NM	12	1,902	0	43	198
Bloomfield	MO	1	130	-19	45	180
Syracuse	NY	-12	122	0	38	200
Blue River	WI	0	226	-17	23	235
Central	AK	28	259	10	14	150
Conway	MO	3	390	-16	37	218
Dequeen	AR	4	195	-14	47	173
Fairbury	NE	6	433	-10	36	211
Glennallen	AK	22	564	52	17	150
Granada	CO	9	1,155	-6	40	206
Haskell	OK	5	212	-16	45	171
Haviland	KS	7	648	-10	43	167
Hillsboro	KS	6	447	-8	38	212
Jayton	TX	8	707	-11	44	209
Lamont	KS	6	306	-12	56	212
Lathrop	MO	4	297	-13	36	215
McCook	NE	8	800	-6	40	165
Medicine Bow	WY	12	1,997	1	38	199
Merriman	NE	9	991	-4	37	164
Neligh	NE	6	524	-8	35	210
Neodesha	KS	5	255	-14	44	172
Okolona	MS	1	125	-22	47	182
Palestine	TX	5	119	-17	45	216
Platteville	CO	11	1,524	0	39	201
Purcell	OK	6	331	-13	41	213
Slater	IA	3	315	-11	33	215
Talkeetna	AK	24	137	130	15	145
Tucumcari	NM	9	1,241	-6	43	204
Vandenberg	CA	15	149	0	48	185
Vici	OK	7	648	-10	44	166
White Sands	NM	10	1,224	-5	46	201
Winchester	IL	1	170	-16	33	219
Winnfield	LA	3	93	-20	48	177
Wood Lake	MN	4	319	-9	36	173

9 Radio Acoustic Sounding System (RASS)

The Radio Acoustic Sounding System (RASS) option enables a wind profiler to simultaneously measure vertical profiles of virtual temperature in the lower troposphere in addition to the three orthogonal wind radial velocities (east, north, vertical).

Temperature measurement capability is from -55 degrees Celsius to +45 degrees Celsius with 0.3 degree resolution. RASS data are acquired in the Vertical beam low mode. Maximum possible height coverage extends from the first range gate (500 m AGL) to the 22nd range gate (5.25 km AGL). Range gate spacing is maintained at 250-meter increments.

The shelter-housed system equipment consists of a workbench/rack which contains a dual channel audio amplifier, audio sweep generator, RS-232/GPIB controller, audio filter, performance monitor, and power supply. RASS signal processing is performed by a dedicated signal processor installed in the existing WPS Signal Processor chassis. The system status monitor wiring and software is modified (EPROM and wiring harness addition). The WPS data processor incorporates additional software to perform RASS control, monitoring, and algorithm functions. Exterior to the shelter are four acoustic transducers (one in each corner of the WPS antenna array) which provide a broad wavefront to maximize the received radar echoes (see Figure 9-1).

Figure 9-1 Wind Profiler with RASS Option Installed

9.1 Theory of Operation

The RASS acoustic signal is a continuously repeating linear frequency sweep from 799 to 968 Hz. This frequency range has been chosen to match the Bragg scattering condition for a radar RF frequency of 404.37 MHz and a temperature range of -55 to +45 degrees centigrade. The Doppler return signal caused by the acoustic wavefront is processed separately from Doppler signal caused by wind velocities. This allows simultaneous measurement of wind velocities and vertical temperature profiles. A 41-stage digital FIR filter in the RASS signal processor separate the radar echoes of the acoustic wavefront and wind velocities resulting in 60 dB attenuation of ground clutter and rain velocity. After filtering, the signal spectrum is analyzed using a 512 point FFT (Fast Fourier Transform). Both digital filtering and FFT analysis are performed by a Texas Instruments TMS 320 DSP chip. For the duration of the vertical low mode, each range bin's 27 spectra are averaged. The averaged spectra for each range bin is sent to the MICROVAX for additional data processing. The Data Processor performs the following computations on each range bin:

- 0th moment (signal strength).
- 1st moment (signal velocity) and conversion to vertical temperature.
- 2nd moment (signal velocity variance) vertical temperature variance.
- Diagnostic Spectrum, 512 pt for one gate, user specified fixed or sequential.

The algorithms used in the above computations are similar to those now used in the Wind Profiler System wind computations.

The acoustic transducers seen in Figure 9-1 are placed in the corners of the antenna to provide a broad wavefront. The serrations along the top of the transducer reduce high amplitude sidelobes by approximately 15 dB thus minimizing acoustic annoyance in the near field.

A warning signal 36 dB below maximum power is outputted approximately 30 seconds prior to the main transmission to alert nearby personnel that a potentially dangerous acoustic level is about to be transmitted. The main acoustic transmission starts 20 seconds before the start of vertical low mode and continues throughout the entire low mode time frame. The number of RASS transmissions and their cycle position is completely programmable via the PMT configuration parameters.

Another feature of the RASS implementation is the ability to select via PMT entry, the starting and ending time for RASS transmission. This is vital at location where, for example, silence must be maintained during evening hours.

Performance monitoring/fault localization (PMFL) is included in the RASS package. it detects failures of the RASS signal processor, audio sweep generator, audio power amplifier, and acoustic transducers. Errors and faults produced by the RASS signal processor and sweep generator/GPIB-RS-232 controller are detected and handled by the Data Processor. The RASS system block diagram is shown in Figure 9-2.

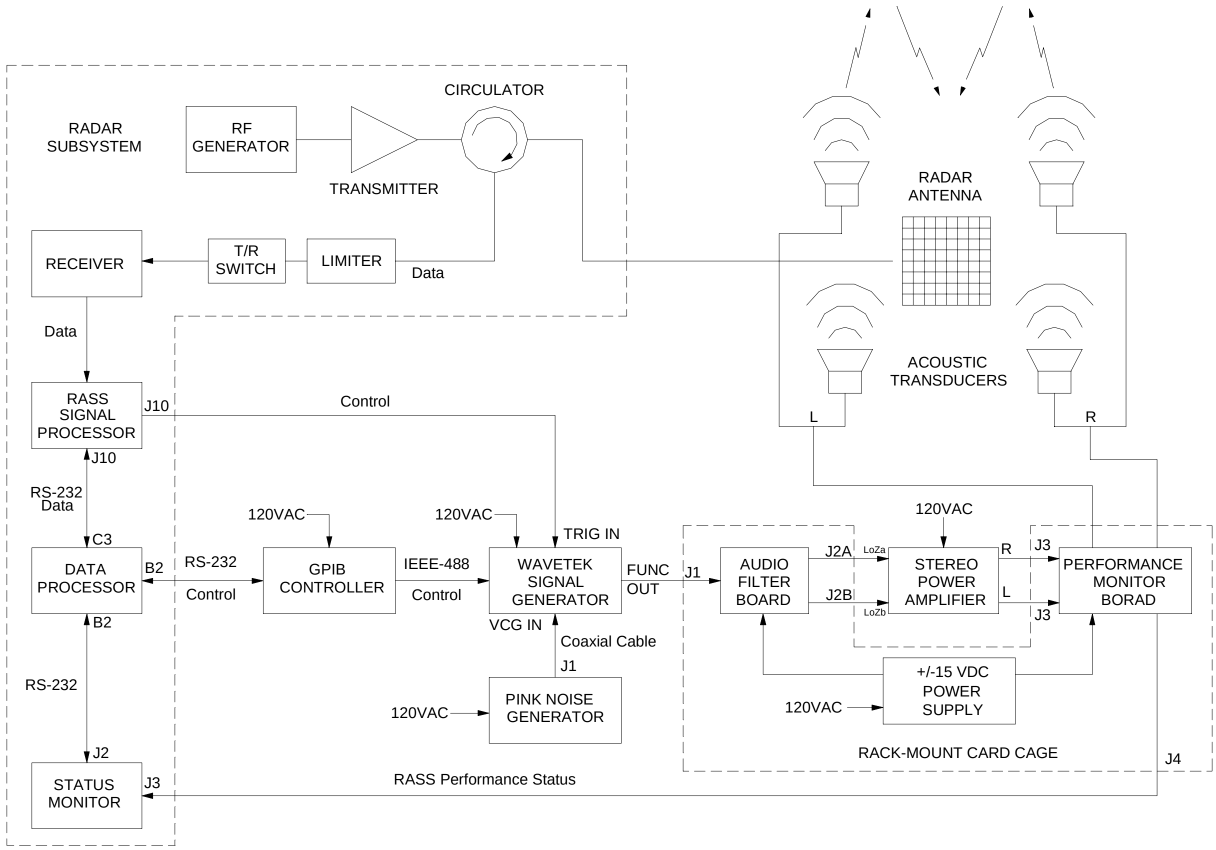


Figure 9-2 RASS System Block Diagram

9.2 Physical Description

Addition of RASS capability to an existing installed Lockheed Martin Wind Profiler System can be accomplished at the site by installing and/or replacing hardware at the LRU level. The modification consists of installing four identical acoustic transducers (one within each corner of the Wind Profiler security fence) a workbench which contains the audio amplifier, sweep generator, GPIB controller, power supply, audio filter and performance monitor LRUs, replacement of the signal processor unit in the equipment rack with a full-up RASS modified signal processor, replacement of the status monitor with a full-up RASS modified status monitor, and replacement of a PROM card in the MICROVAX data processor with a PROM card that contains both WPS and RASS software. Also a new PMT software disk is provided which contains the additional RASS parameter menus.

9.2.1 RASS Equipment

The RASS Workbench shown in Figure 9-3 (front view) and Figure 9-4 (rear view) replaces the workbench in the profiler shelter. The function of the components installed in the RASS Workbench are to generate the acoustic energy and detect failures of amplifiers and transducers. The following sections describe the function of each of the components in the RASS system.

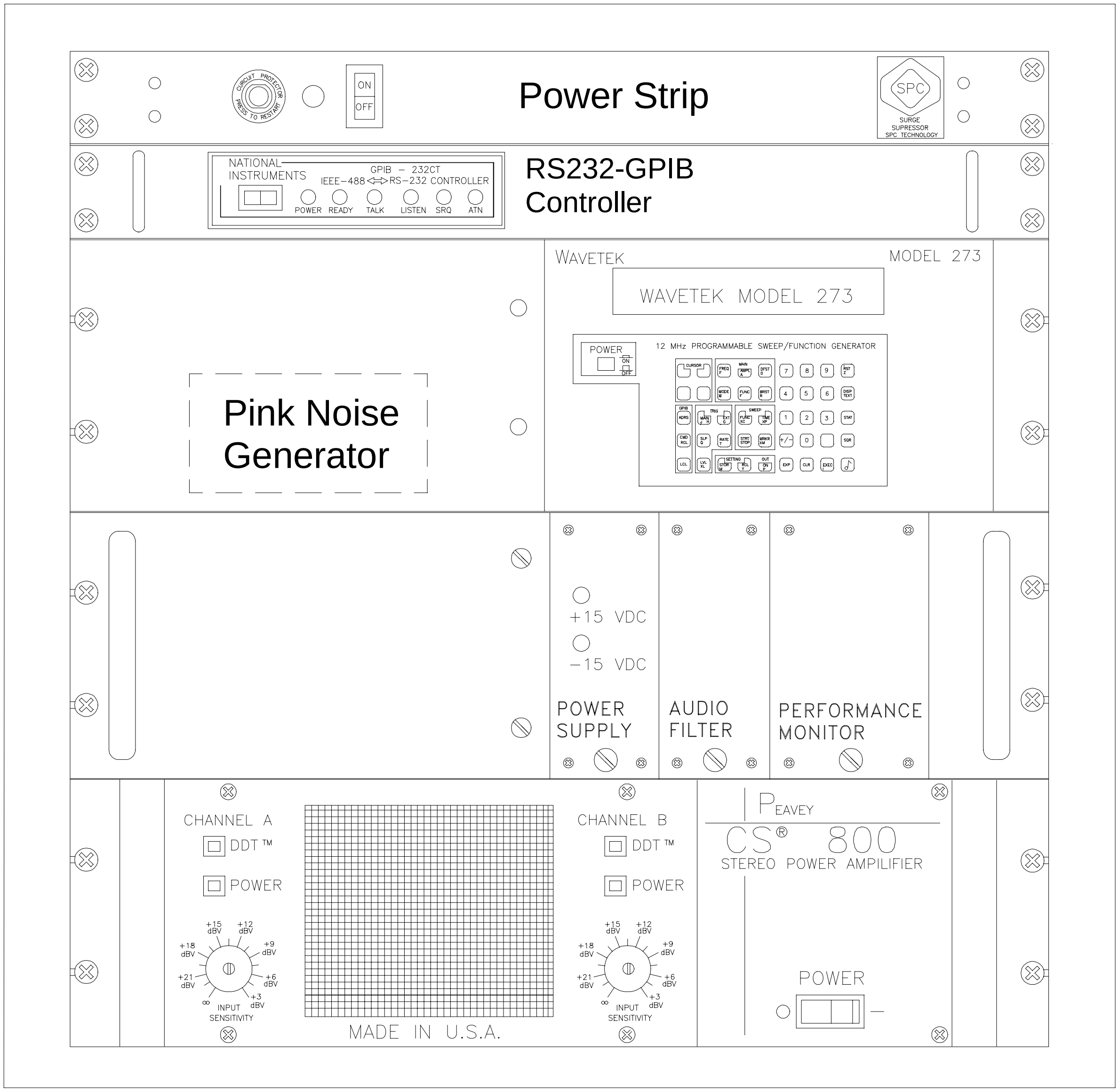


Figure 9-3 RASS Workbench/Rack Front Panel View

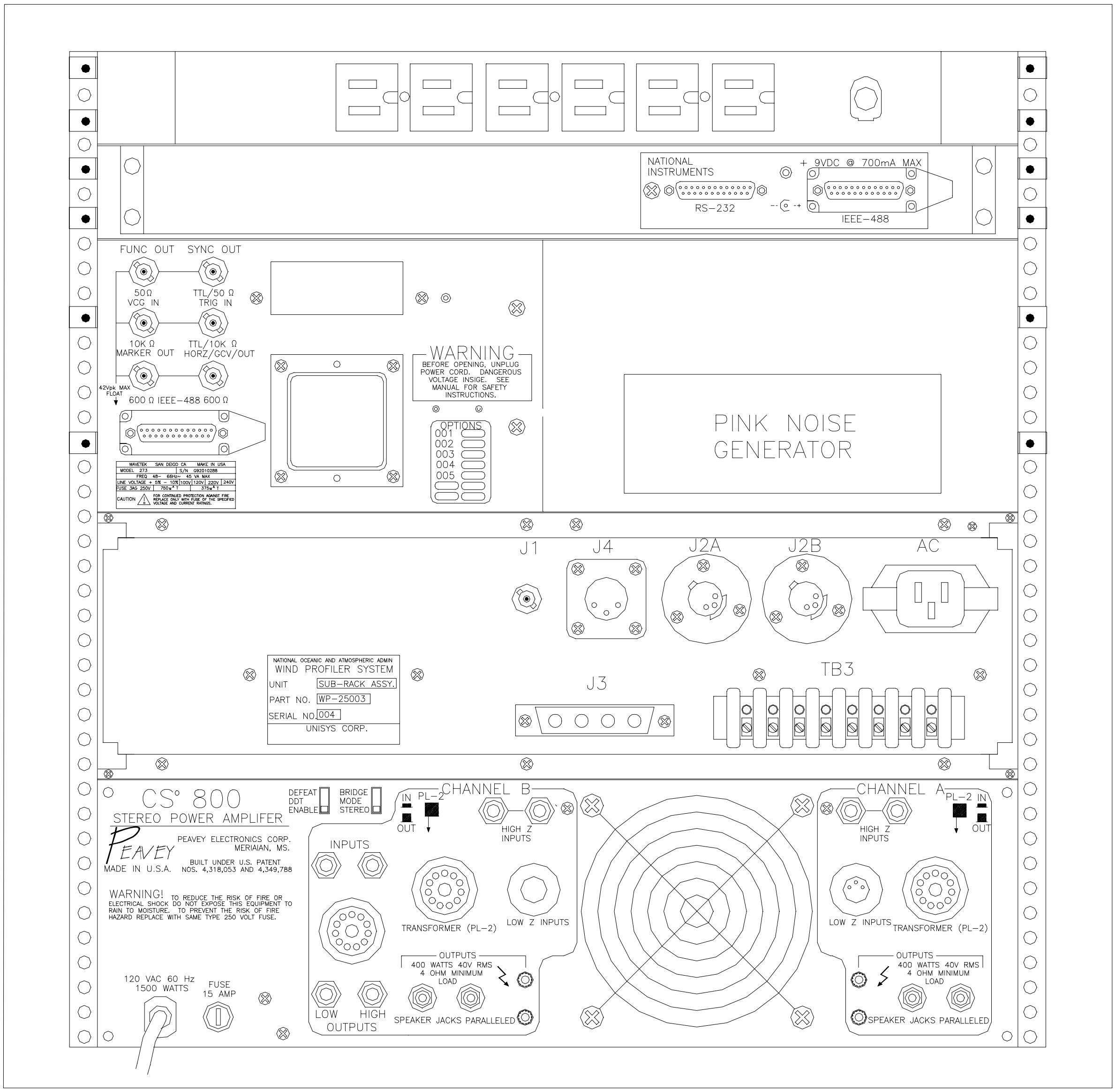


Figure 9-4 RASS Workbench/Rack Rear Panel View

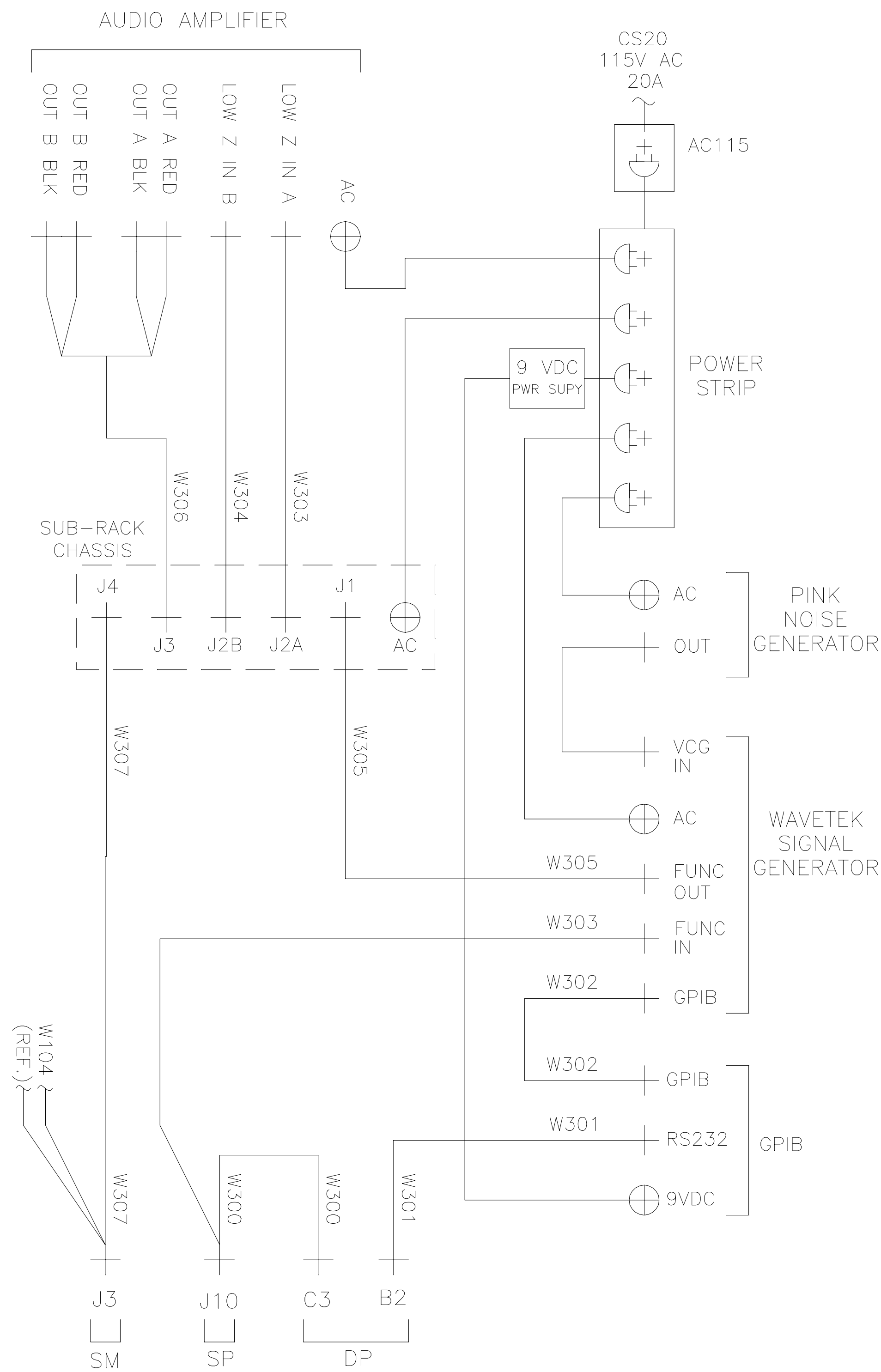


Figure 9-5 RASS Equipment Interconnection Diagram

9.2.1.1 GPIB/RS-232 Controller

The GPIB/RS-232 controller receives commands (RS-232 serial) from the Data Processor and converts them to GPIB/IEEE-488 format. The commands are then passed on to the Sweep Generator. The GPIB/RS-232 interface connectors are located in the rear panel of the unit. Internal dip switches must be set to the following values for proper operation. (Switch 1 -8 required options are underlined.)

Switch 1: <u>Off S-mode</u>
On G-mode

Switch 2: Off 7 bits/character
<u>On 8 bits/character</u>

Switch 3: <u>Off 1 stop bit/character</u>
On 2 stop bits/character

Switch 4: <u>Off Parity generation/checking disabled</u>
On Parity generation/checking enabled

Switch 5: <u>Off Odd Parity</u>
On Even Parity

Switches 6-7-8 Control the baud rate (use 9600).

Switch 6	Switch 7	Switch 8	Baud Rate
OFF	OFF	OFF	300 baud
OFF	OFF	ON	600 baud
OFF	ON	OFF	1200 baud
OFF	ON	ON	2400 baud
ON	OFF	OFF	4800 baud
ON	**OFF**	**ON**	**<u>9600 baud</u>**
ON	ON	OFF	19200 baud
ON	ON	ON	38400 baud

9.2.1.2 Sweep Generator

The Sweep Generator (see Figure 9-6) provides the acoustic sweep as commanded by the system data processor (and triggered by system signal processor). Various test signals are programmed into the sweep generator for troubleshooting/testing purposes.

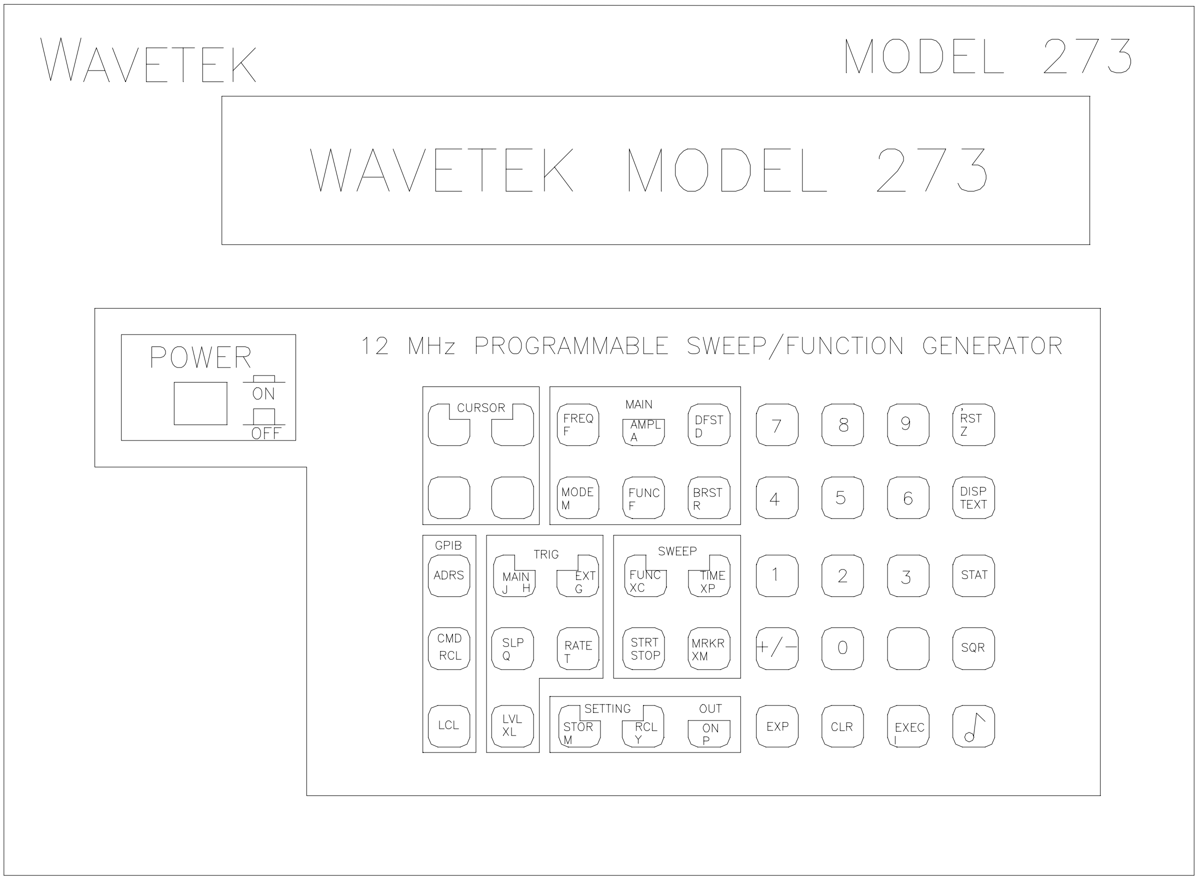


Figure 9-6 WaveTek Generator Front Panel

9.2.1.3 Sub-Rack Chassis

THe Sub-Rack Chassis provides equipment interconnections and modular mounting for the VDC Power Supply, Audio Filter, and Performance Monitor cards. A wiring schematic for the Sub-Rack Chassis is provided in Figure 9-7.

9.2.1.3.1 15 VDC Power Supply

This module is and integrated AC-DC converter and supplies +15 and -15 VDC for the active audio filter and performance monitor's analog circuitry. See Figure 9-8 and Figure 9-9 for power supply component and schematic diagrams.

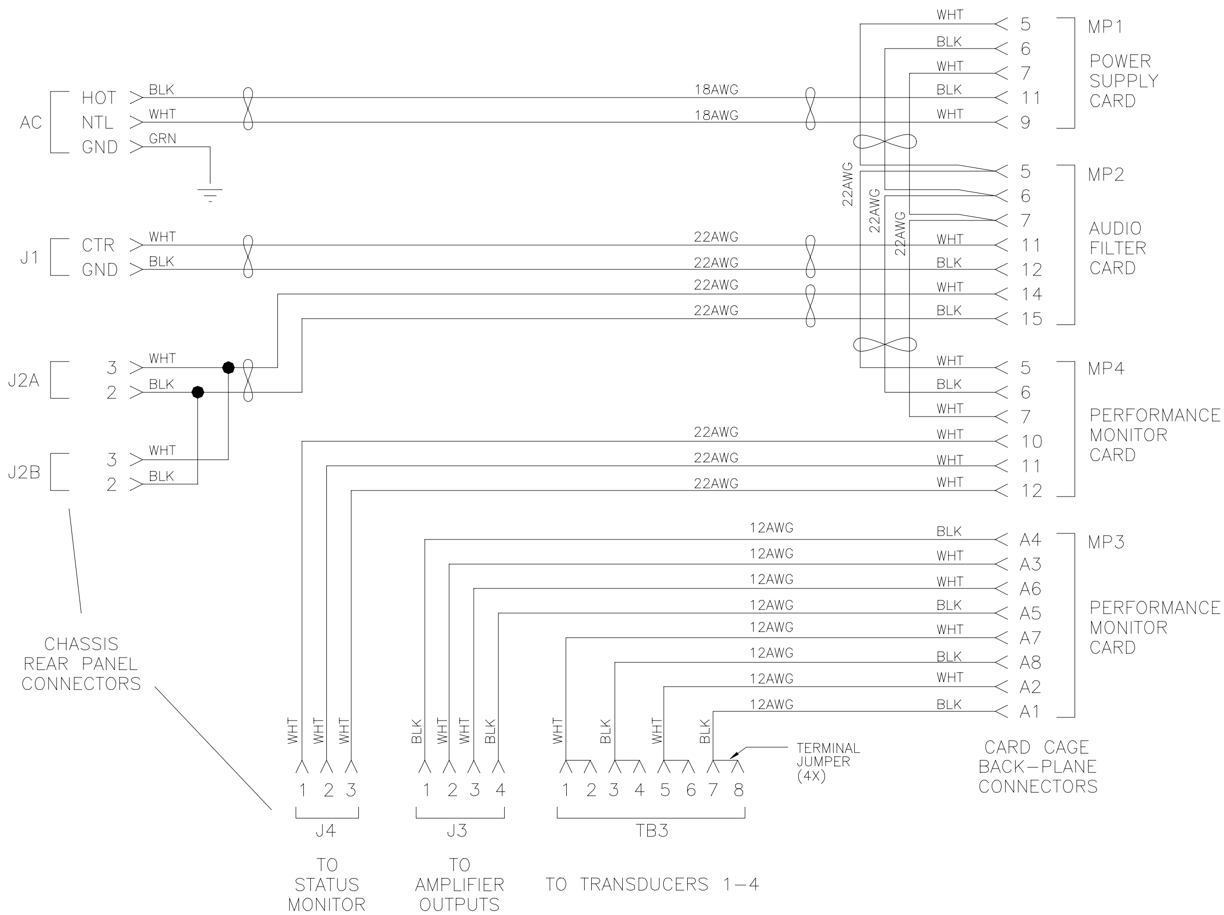


Figure 9-7 Sub-Rack Chassis Wiring Schematic Diagram

9.2.1.3.2 Audio Filter Module

The Audio Filter Module filters the output of the Sweep Generator, removing harmonics from the Bragg pass band region. Its center freq is 870 Hz with a Q of »0.85. Audio Filter Module component layout and schematic diagrams are shown in Figure 9-10 and Figure 9-11.

9.2.1.3.3 Performance Monitor Module

The performance monitor module measures the high power sweep output of the audio amplifier. Active electronics sense power amplifier output voltage and acoustic transducer current draw. Voltage and current parameters are monitored by the system status monitor for fault location purposes. Performance Monitor module component layout and schematic diagrams are shown in Figure 9-12 and Figure 9-13.

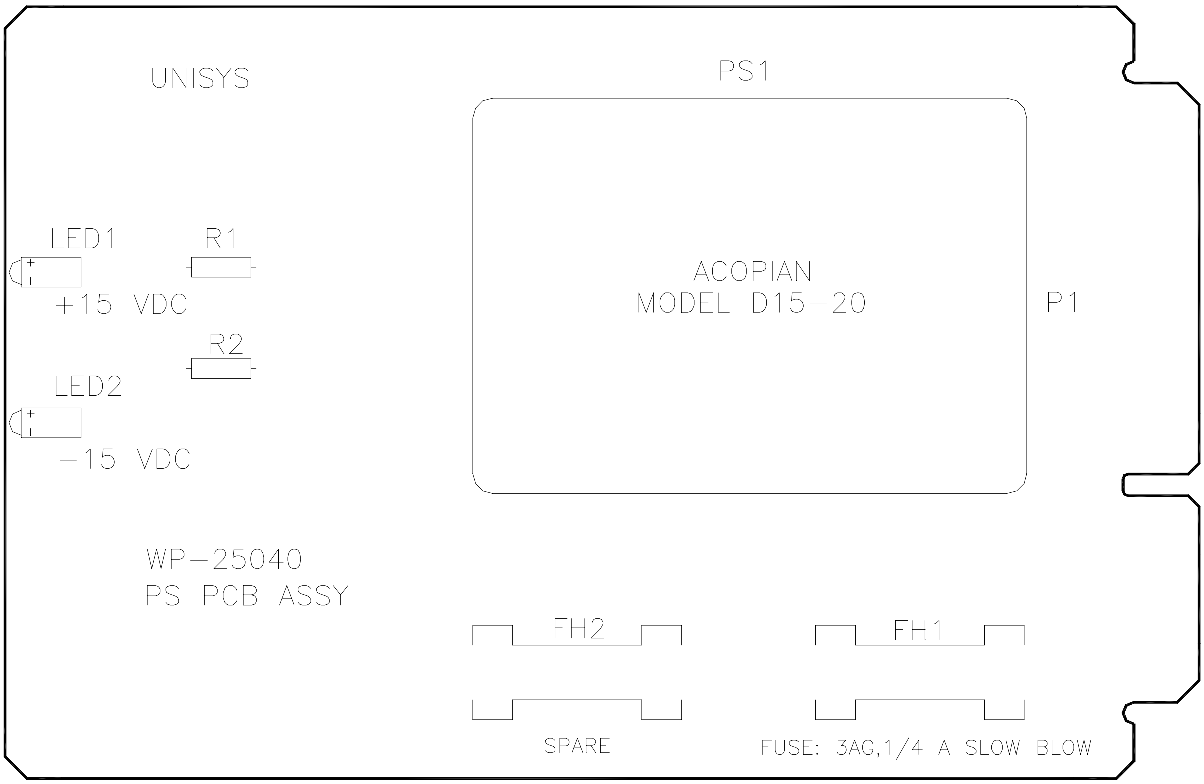


Figure 9-8 +/- 15 VDC Power Supply Board Component Layout

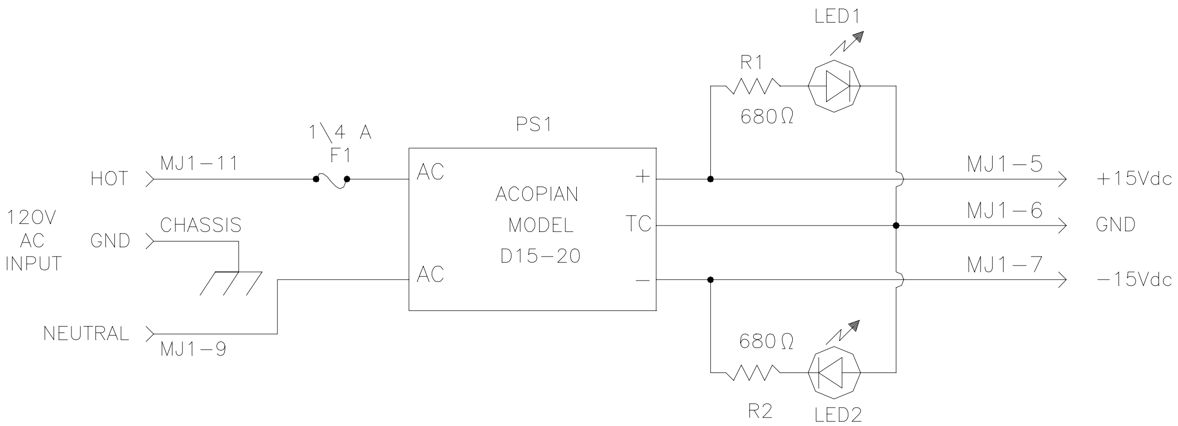


Figure 9-9 +/- 15 VDC Power Supply Schematic Diagram

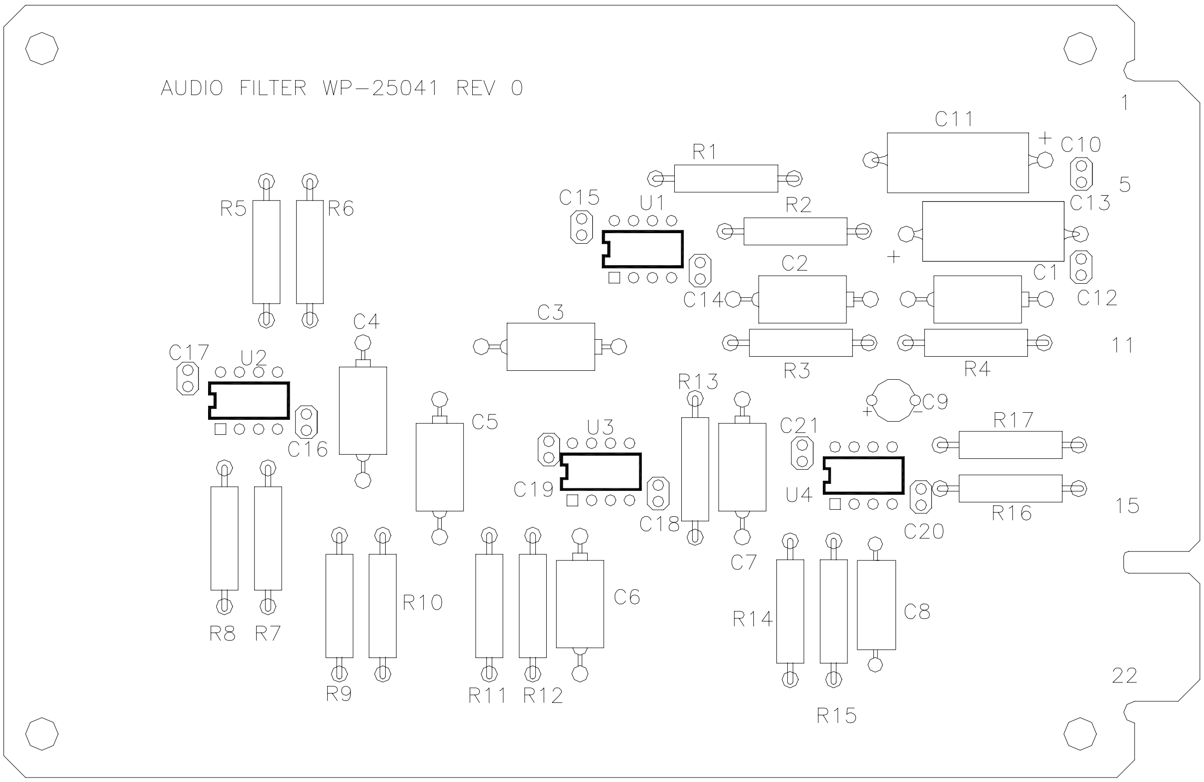


Figure 9-10 Audio Filter Board Component Layout

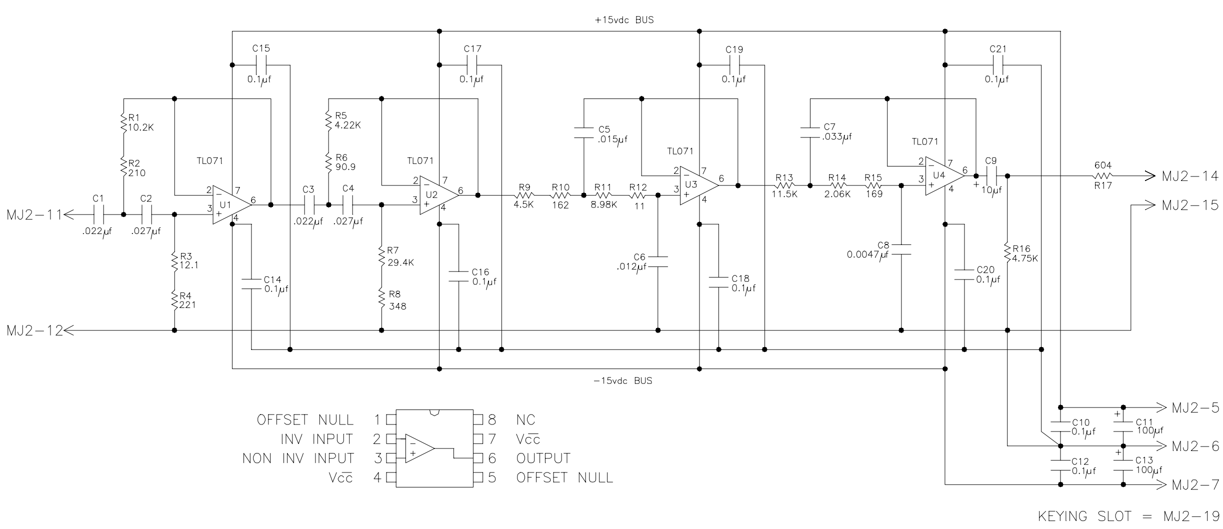


Figure 9-11 Audio Filter Board Schematic Diagram

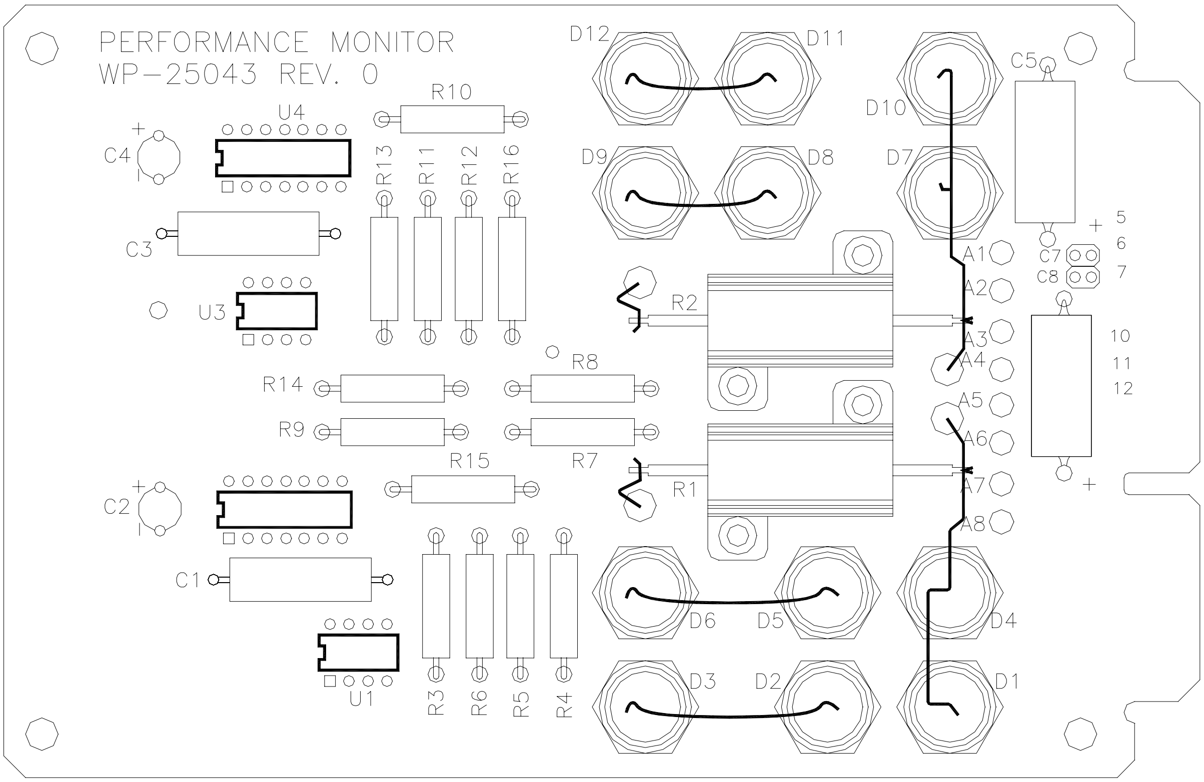


Figure 9-12 Performance Monitor Board Component Layout

9.2.1.4 Power Amplifier

The power amplifier is a *Peavey* professional quality stereo audio amplifier with built in short circuit protected outputs. The amplifier is capable of delivering 800 watts into 4 ohms, but the gain controls are manually setup for 100 watts into 8 ohms.

9.2.1.5 Pink Noise Generator

The pink noise generator sends a random phase modulated signal to the sweep generator VCG port. This effectively convents the CW Sweep center at 870 Hz to a random phase modulated sweep at 870 Hz. The result is a random noise acoustic output which is more pleasant to the human ear than a constant ramped sweep.

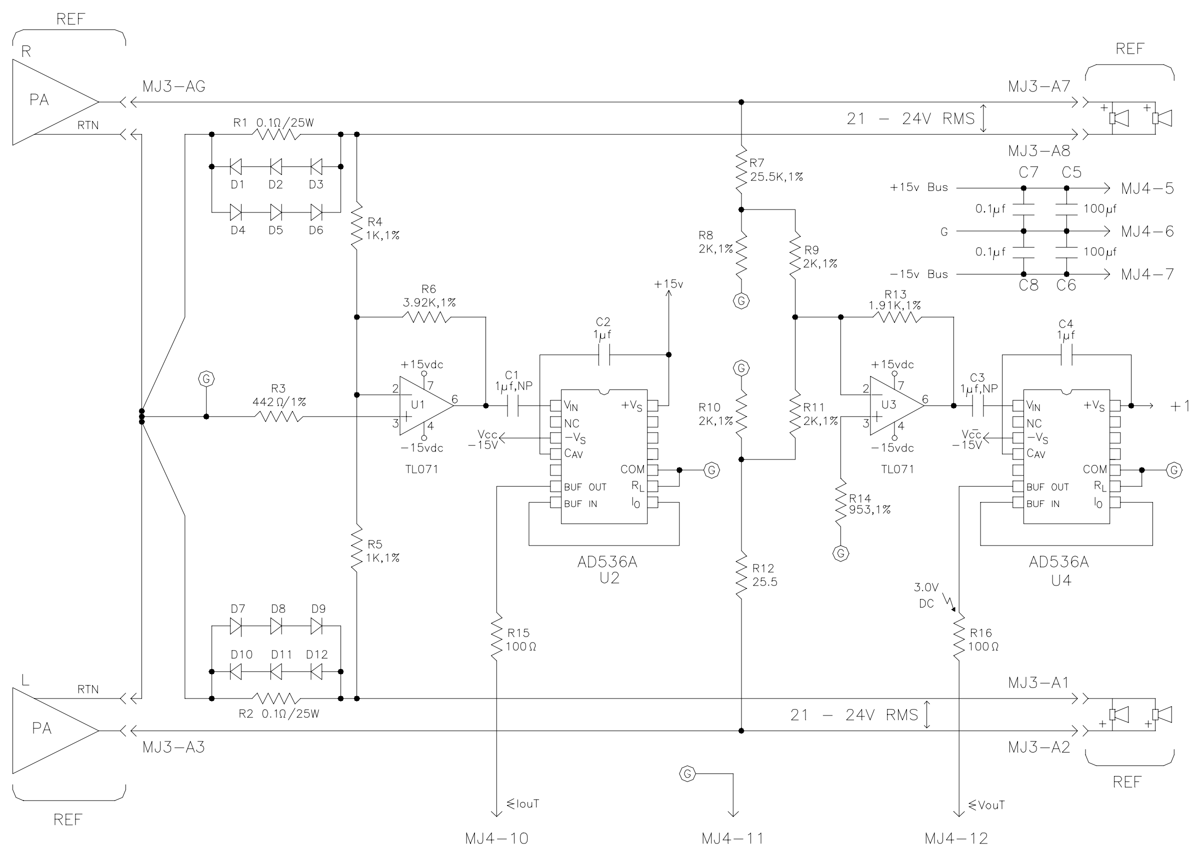


Figure 9-13   Performance Monitor Board Schematic Diagram

9.2.1.6   Transducer Assemblies

The acoustic transducer assemblies located at the for corners of the co-co antenna are shown in Figure 9-1. The assemblies contain the following key components shown in Figure 9-14.

- Speaker - (actual acoustic transducers)
- Reflector - (heated).

The acoustic transducers assembly shown in Figure 9-14 operates as follows: The high power acoustic signal is emitted by the speaker/horn assembly. This audio energy is concentrated and reflected to the atmosphere by the heated reflector assembly. Insulation on the interior wall of the transducer assembly and the tapered edging along the top perimeter reduce near field audio levels minimizing lateral noise propagation. The reflector contains a 900 watt thermostatically controlled heating element to prevent ice (snow build up on the reflector during severe environment conditions). The speaker (also referred to as the compression driver) is completely housed in the horn assembly to protect from moisture/rain damage.

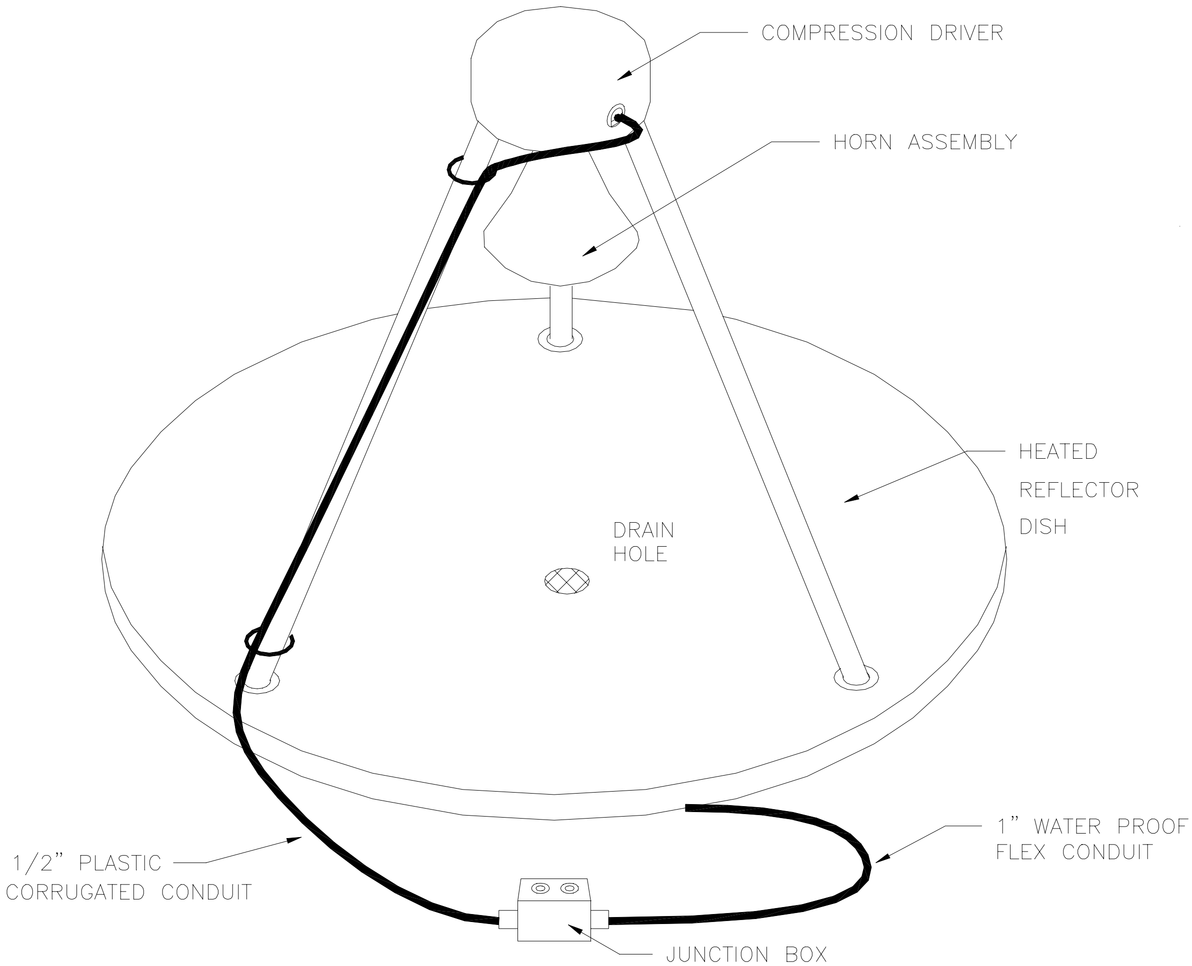
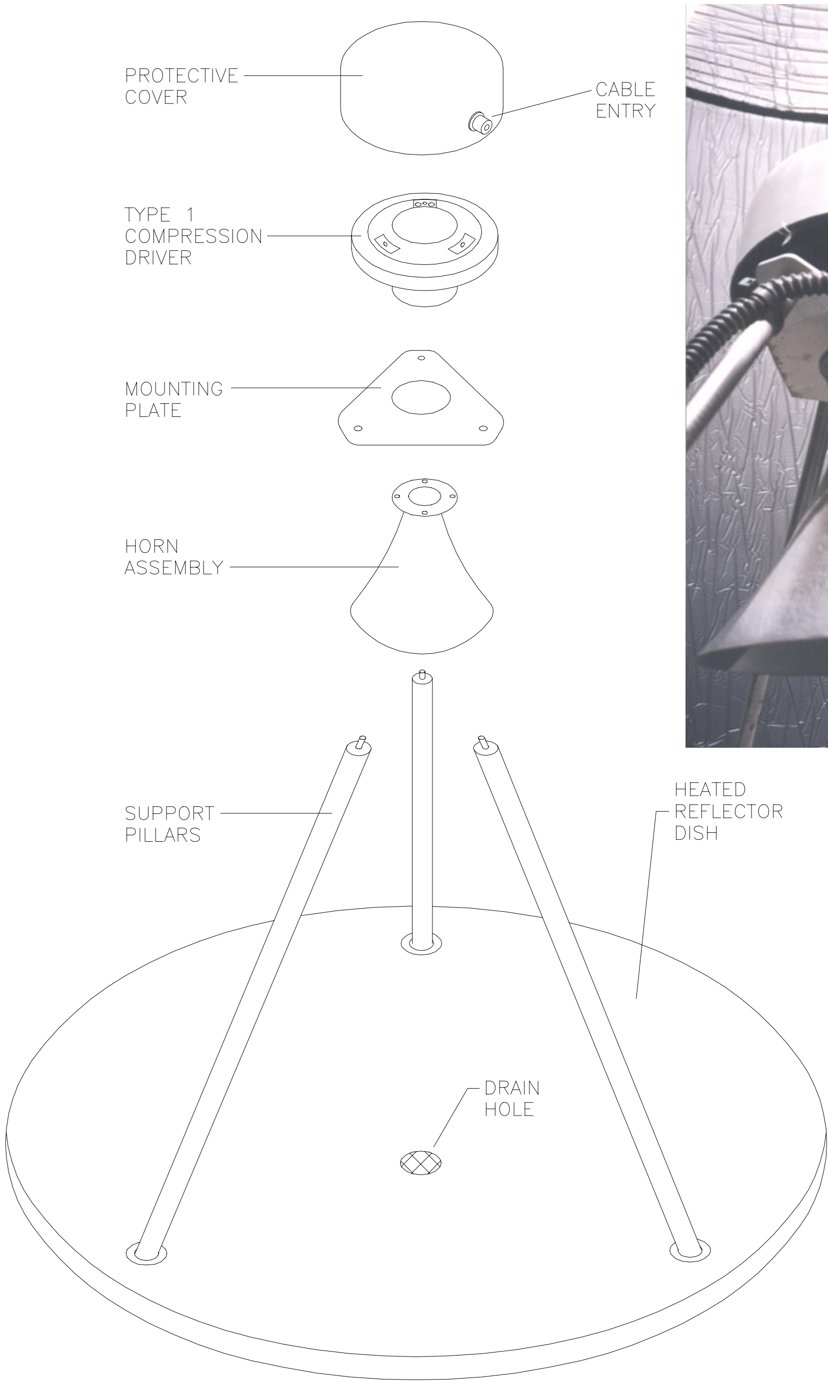


Figure 9-14 RASS Transducer Assembly

Two versions of transducer assemblies are currently used at profiler sites. Type 1, the first generation transducers, are used at PLTC2, PRCO2, HVLk1, WSMN5, and SYCN6. Type 2 transducer assemblies, a more recent enhanced design are is used at HBRK1, VCIO2, and HKL02 profiler sites. There are major differences between Type 1 and Type 2 transducer assemblies, and therefore, Type 1 transducer assembly components can not be used at site with Type 2 transducers. The following figures describe the major physical differences between Type 1 and Type 2 transducer assemblies.

Figure 9-15   Type 1 RASS Transducer Enclosure



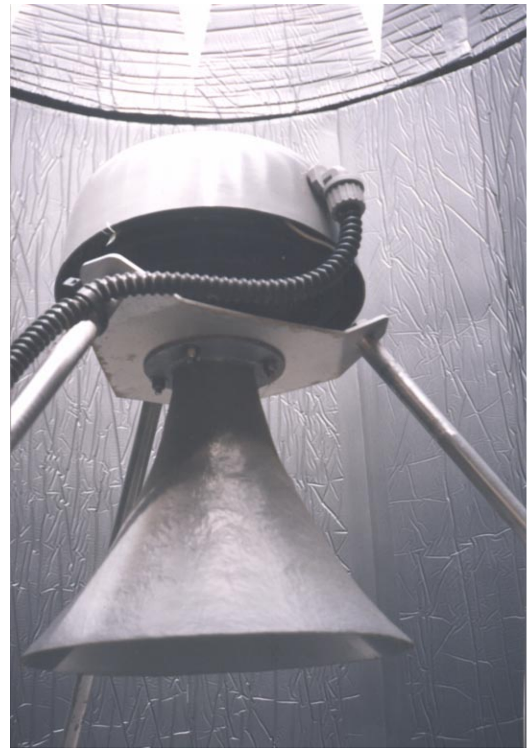


Figure 9-16 Type 1 RASS Transducer Assembly

Figure 9-17 Type 2 RASS Transducer Enclosure

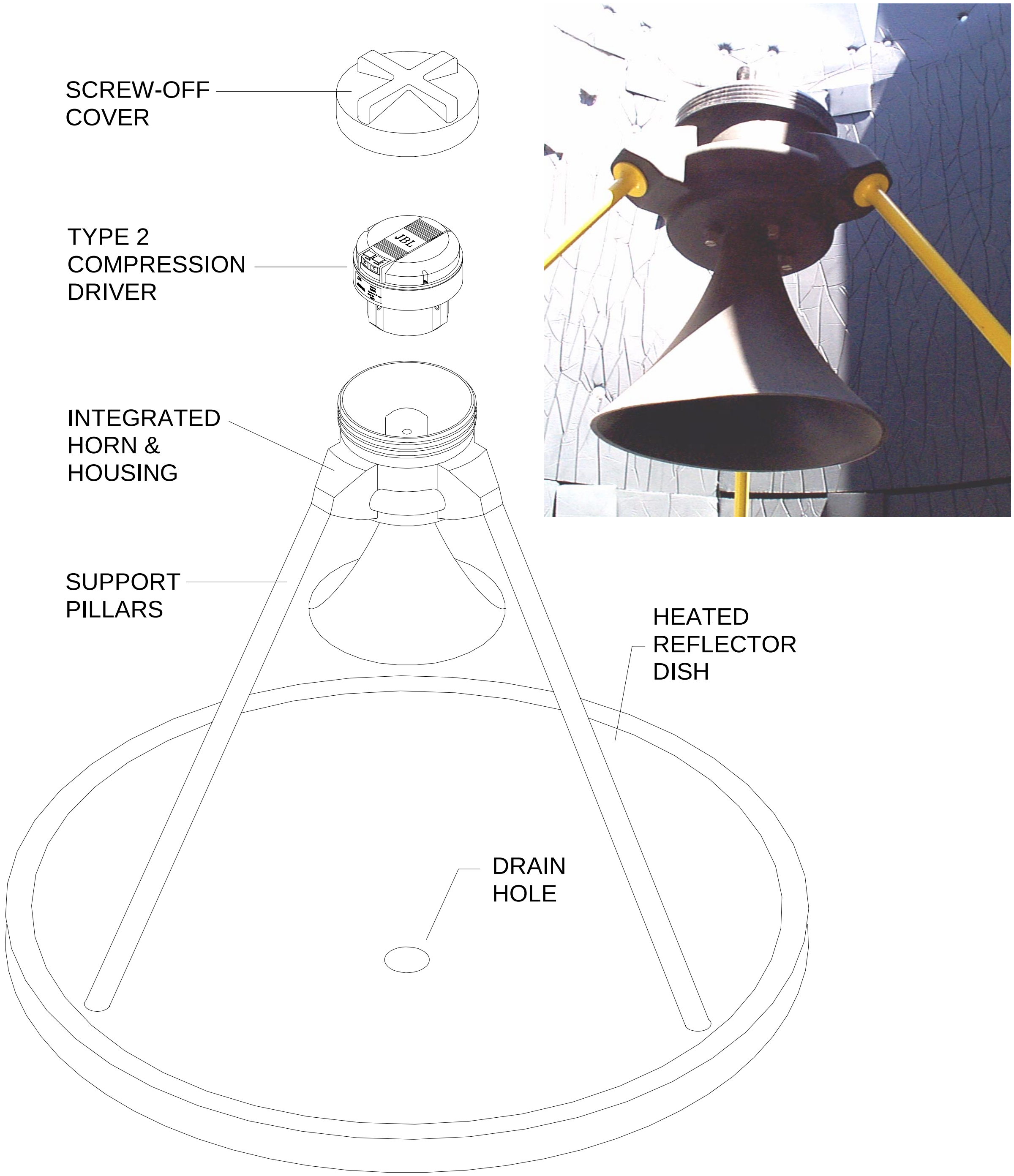


Figure 9-18 Type 2 RASS Transducer Assembly

9.2.2 Modifications to Existing LRUs

9.2.2.1 RASS Signal Processor Modification

When a wind profiler site is equipped with RASS, the Signal Processor chassis is modified to include the RASS signal processor board. Interior to this chassis, a smaller circuit board for RASS processing mounts above the system signal processor board (piggy-back). The chassis rear panel is modified to include connector J10 which provides data, commands, and triggers with the Data Processor and RASS equipment.

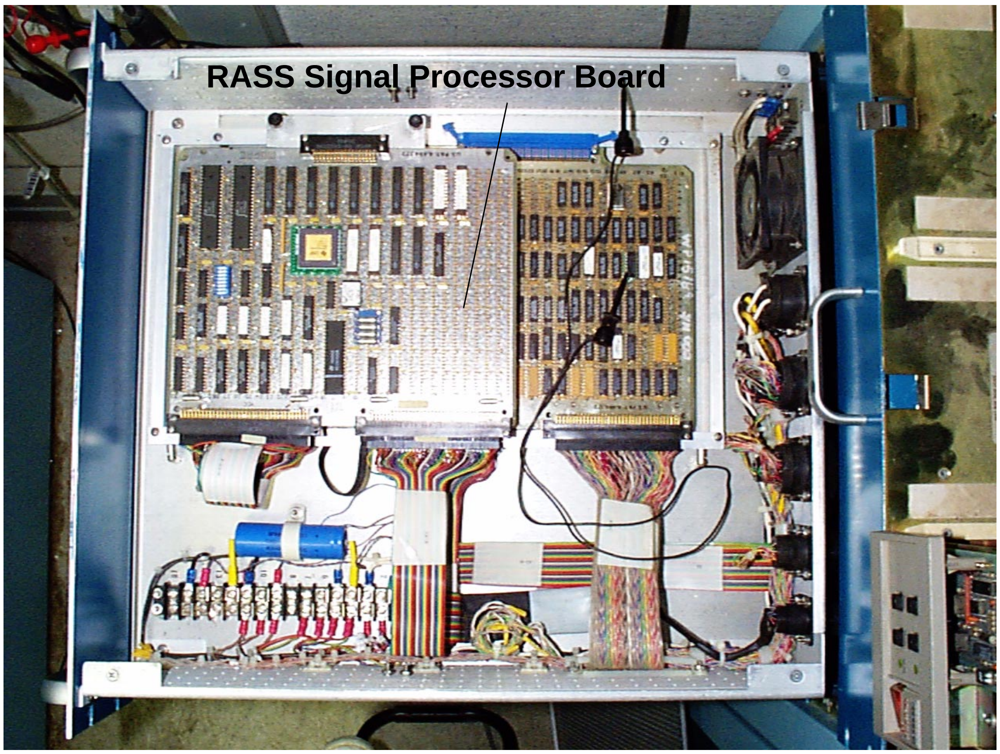


Figure 9-19 RASS Modified Signal Processor (Top View)

9.2.2.2 RASS Status Monitor Modification

To monitor RASS performance, the Status Monitor's chassis wiring and analog interface card are modified to accept power amplifier and acoustic transducer outputs from the RASS workbench performance monitor module. Wiring modifications are made to connector J8 on the Status Monitor rear panel. Also, the Status Monitor's two PROM ICs, U41 and U74 are changed to a RASS capable version (see Figure 4-25).

9.2.2.3 Data Processor Firmware Modification

All RASS radars receive with the modification a new data processor PROM/ROM module which contains the normal wind profiler and also additional RASS software. The module replaces the existing **VER 8.2** WPS software PROM/ROM in the Data Processor (DP) and is called **VER 9** (see Section 4.4.1). Note that if the DP is replaced at a RASS site, the PROM board from the failed DP must be installed in the replacement DP (in short, Version 9 PROM boards stay with the profiler site).

9.2.2.4 PMT Software Modification

In order for the PMT to properly interpret and set up RASS parameters each site is provided an upgraded 3.5” diskette for the Portable Maintenance Terminal. The software is suitable for the RASS system and is referred to as PMT Revision 5.

9.3 Operations

9.3.1 Power-On Procedure

A normally aligned RASS subsystem (shelter electronics workbench) is turned on for operation by simply ensuring that all power sources associated with the electronics are energized. This includes the RASS circuit breaker (one) and RASS Transducer heater element circuit breakers (two) located in the shelter power distribution panel. Also at the workbench the AC power strip, GPIB/RS-232 controller, sweep generator, and power amplifier LRUs should be energized. Once this occurs the operator then must select the RASS option on the PMT and set the associated RASS site specific parameters. Fully automatic operation will then occur with each Vertical beam.

9.3.2 Power-Down Procedure

The RADAR may be left in operational mode and cycling through the beams while maintenance is performed on the RASS subsystem. If only interior electronics are to be investigated, the RASS workbench circuit breaker should be de-energized. If exterior maintenance is to be performed, both transducer heater element circuit breakers and the RASS workbench circuit breaker should be turned-off. If maintenance of the RADAR interface and/or associated radar electronics (i.e., Status Monitor, Data Processor, or Signal Processor) needs maintenance then the associated circuit breaker at the power distribution panel should be de-energized (i.e., breakers #19, #22 and #24).

9.3.3 Configuring RASS Parameters

The Data Processor's setup parameters must be properly configured for RASS to operate. The PMT provides a *RASS Operations Menu* that allows the user to configure RASS parameters. The radar must be in *Maintenance* mode for change any parameters. Once in *Maintenance* mode, select ***Auxiliary operations*** from the PMT ***Main Menu***, select ***Select RASS Menu***, a screen similar to Figure 9-20 is displayed on the PMT. Descriptions of each parameter are outlined below.

PMT RASS Parameters Menu		
RASS Selected	Y	[Y]es or [N]o
Start time	12	hour 00 - 23
End time	12	hour 00 - 23
When: 1111111111		1 = On, 0 = Off (Sub-Hourly Cycle Times)
0123456789		Six-Minute 0 = hh:00, 9 = hh:54
Sweep start Frequency	0875	Hz
Sweep stop Frequency	0876	Hz
Amplitude Attenuation	03	dBm 00 - 15
Single/Multiple	M	S or M, Diagnostic Spectra
single diag. gate	N	
diag. gate	01	

Figure 9-20 PMT RASS Parameters Menu

RASS Selected - RASS soundings can be enabled for disabled.

Start and End Times - Defines the hours during the day when RASS soundings occur. Setting the start time equal to the end time causes the RASS to run 24 hours a day. This option can be used to turn the RASS *OFF* at night.

When: - Defines sub hourly (or six-minute cycle times). Allows the RASS to be shut off during any 6-minute cycle during the hour.

Sweep Start and End Frequency - Parameters used to instruct the WaveTek Sweep Generator what frequency range to sweep through. If a pink noise generator is being used, the sweep can be narrow (from 875 Hz to 876 Hz). If a pink noise generator is not being used, set the start frequency to 799 Hz and end Frequency to 968 Hz.

Amplitude Attenuation - Allows the overall volume to be attenuated by up to 15 dBm. The nominal value for this parameter is 3 dBm.

Single/Multiple - Instructs the WaveTek Generator to do a slow ramping sweep over a 1-minute period (Single), or sweep rapidly (1-second) using the specified start and end frequencies.

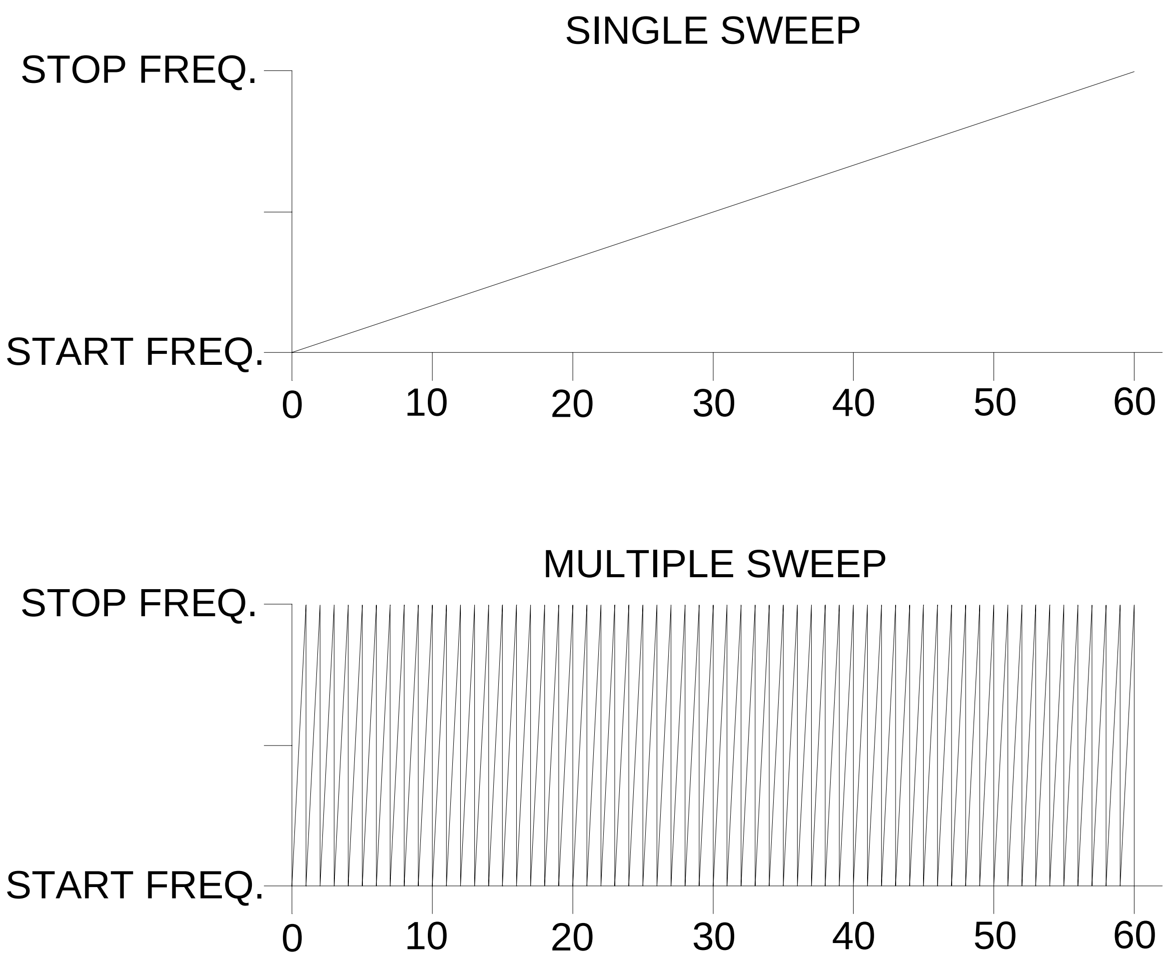


Figure 9-21 Single/Multiple Sweep Parameter Settings

Single Diag Gate - The diagnostic spectral data for one (out of 22) RASS range gates are transmitted in the 6-minute landline message. Normally the diagnostic spectra rotates, sequentially stepping through one range gate every 6-minutes. Setting this parameter to *Single* forces the Data Processor to send the diagnostic spectra for the same range gate in each consecutive 6-minute landline message.

Diagnostic Gate - This parameter allows the user to select which range gate's spectral data is transmitted in each 6-minute landline message. *Single Diag Gate* must be set to ***"S"*** for this parameter to take effect. Valid range gate values are **01 - 22**.

9.3.4 Configuring RASS Clutter Flags

Ground clutter is caused by stationary (non-moving) objects that cause large signal returns at fixed-velocities. Ground Clutter Flags provide a means to suppress ground clutter in the RASS spectral data. One ground clutter flag value can be set in each of 22 range gates. A clutter flag consists of a spectral width value and a center point value.

PMT RASS Clutter Flag Menu					
Vertical Beam Low Mode					
Gate:Spectral Points:Center Point					
01:01:249	02:01:249	03:01:249	04:01:249	05:01:249	06:01:249
07:00:000	08:00:000	09:00:000	10:00:000	11:00:000	12:00:000
13:00:000	14:00:000	15:00:000	16:00:000	17:00:000	18:00:000
19:00:000	20:00:000	21:00:000	22:00:000		
Valid Spectral Point:	Odd Numbers 01 - 25				
Valid Center Point:	118 - 420				

Figure 9-22 PMT RASS Clutter Flag Menu

9.4 Calibration

When the RASS system is sounding, the RASS Performance Monitor Module measures the power amplifier's output voltage levels and the amount of current being drawn by the four transducers. Amplifier and transducer failures are detected when the voltage and/or current levels exceed specified thresholds. In order for the monitoring circuitry to function correctly, the power amplifier output levels must be adjusted to a known value. The calibration process entails measuring the AC RMS voltage at the power amplifier output while the RASS system is sounding during the vertical low mode of the profiler cycle. Then, the output level of the power amplifier is adjusted accordingly.

1. Login to the profiler using the PMT. Place the radar into *Maintenance* mode.

2. Select ***Auxiliary Operations*** menu from the ***Main Menu.*** Select ***RASS Operations Menu*** from the ***Auxiliary Operations*** menu. A display similar to Figure 9-20 is shown on the PMT screen.

3. Set the RASS Amplitude Attenuation value to 0 dBm. Return the radar to *Operational* mode.

4. Connect a True RMS voltmeter to the output binding posts of Channel A on the rear panel of the power amplifier (see Figure 9-23).

5. While the RASS is sounding at its full volume (during the vertical low mode), adjust the Channel A *Input Sensitivity* control potentiometer on the power amplifier front panel to achieve between 20 to 24 VAC RMS (see Figure 9-23). The adjustment pots have detentes that quantize the amount of change, one additional “click” of the pot may cause the voltage to go over or under the desired range. Never exceed 24 VAC RMS, this can damage the compression drivers (speakers). It is better to be on the lower side of the threshold than risk blowing out a compression driver.

6. Repeat steps 4 and 5 for channel B on the power amplifier.

7. Place the radar into *Maintenance* mode.

8. Select ***Auxiliary Operations*** menu from the ***Main Menu.*** Select ***RASS Operations Menu*** from the ***Auxiliary Operations*** menu. A display similar to Figure 9-20 is shown on the PMT screen.

9. Set the RASS Amplitude Attenuation value to 3 dBm. Return the radar to *Operational* mode.

10. With 3 dBm of attenuation, the output voltage of the power amplifier should drop to approximately 14-15 VAC RMS.

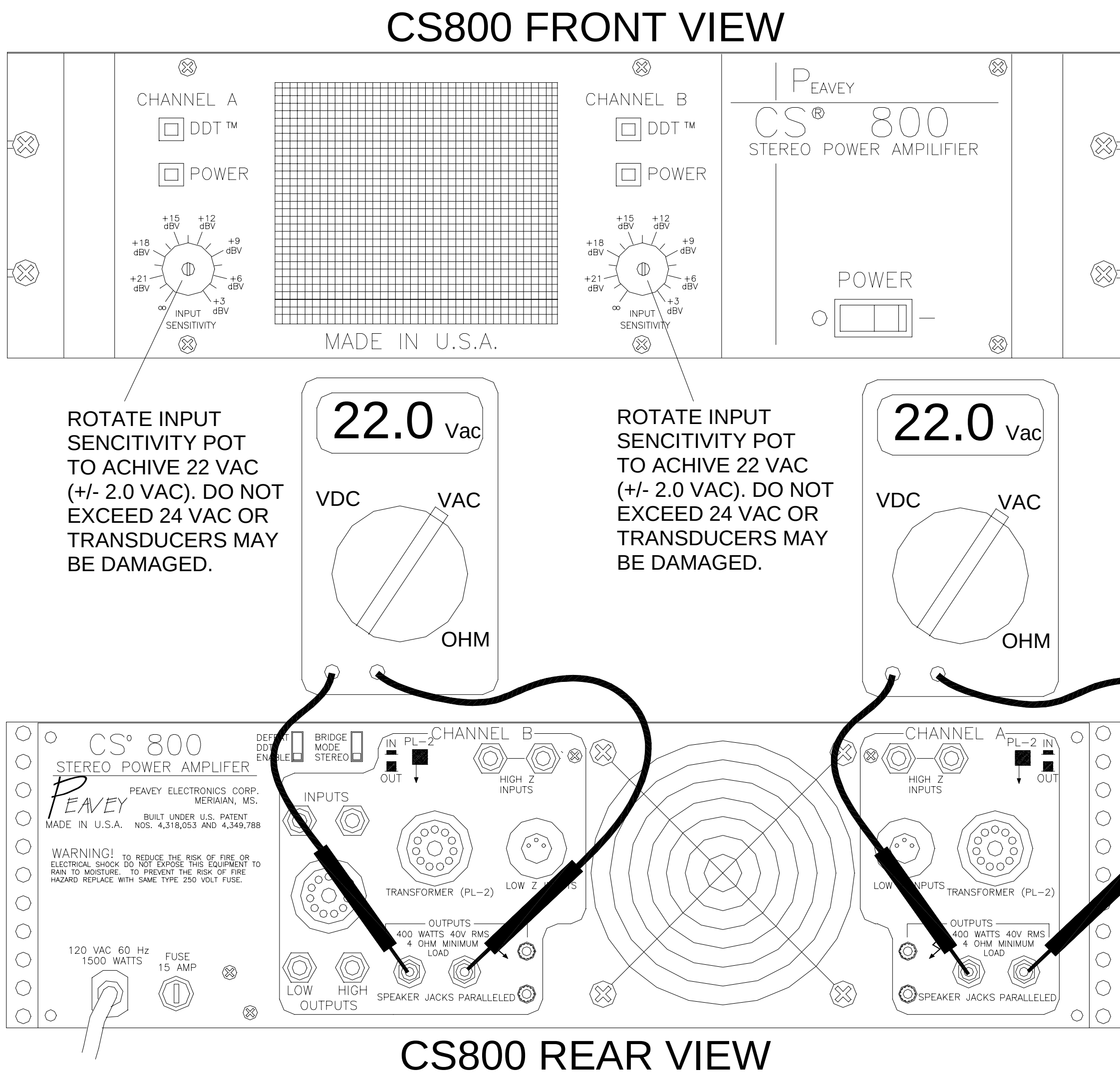


Figure 9-23 Measuring and Calibrating RASS Power Amplifier

9.5 Preventive Maintenance

9.5.1 Transducer Maintenance

The transducer assemblies are exposed to the elements and therefore will inevitably require preventive maintenance to function correctly. The foam that lines the inside of the enclosure is susceptible to UV deterioration, water intrusion, and rodent or insect damage. The foam itself does nothing except minimize the lateral propagation of noise, this can become a real issue if the site is located near a residence. In worse case scenarios, the foam becomes water-logged, rips away from the side of the enclosure, and ends up piling-up in the reflector dish. Objects in the dish degrade the transducer operation significantly.

Preventing water intrusion into the foam is probably the single most important preventive maintenance activity. At the top of transducer enclosure are triangle shaped extensions called “Thanaders”. The thanaders are lined with foam, the cut edges of the foam provide a sponge for absorbing water. Sealing the exposed edges of the foam with UV-resistant silicone will prevent water intrusion (see Figure 9-24).

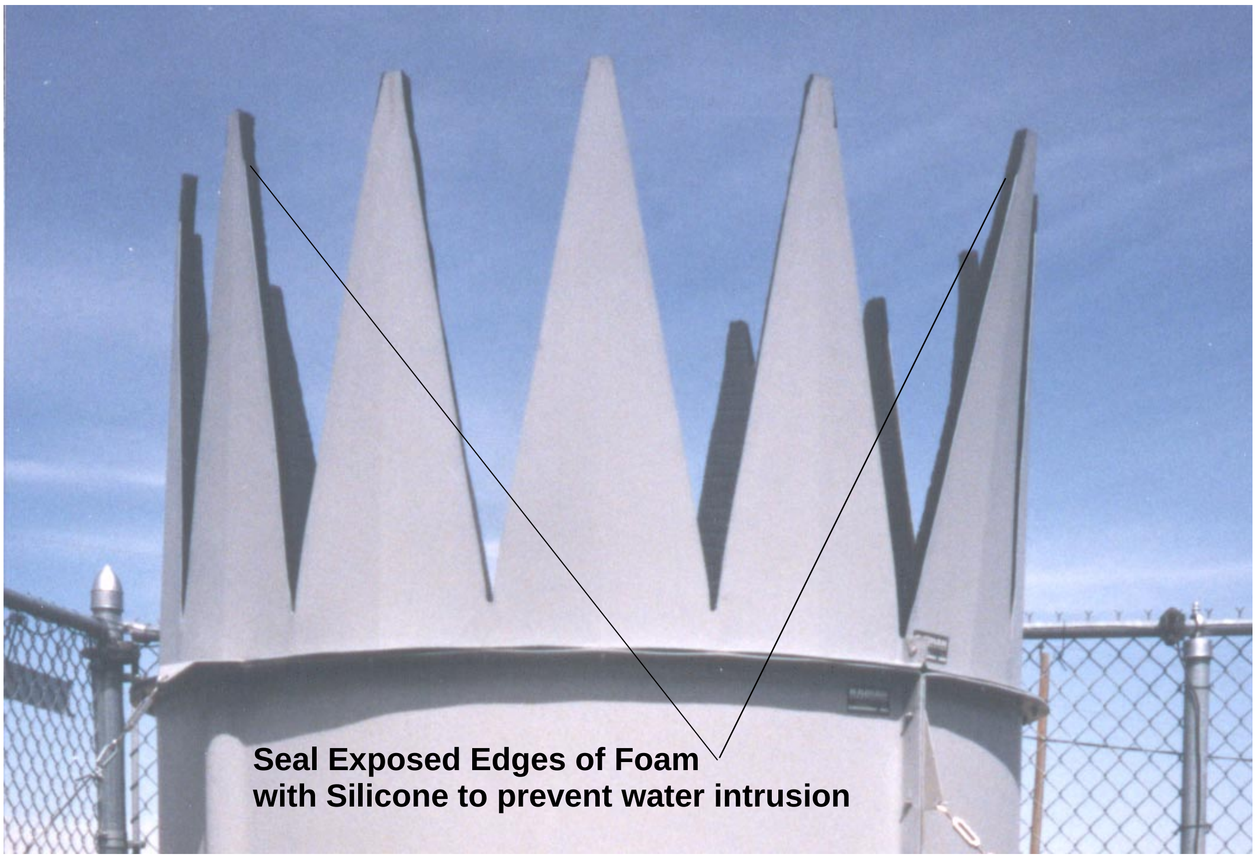


Figure 9-24 Weather Sealing RASS Transducer Enclosure Foam

Preventing rodent and insect intrusion is important from a maintenance perspective. Technicians performing maintenance on the RASS system my be placed at risk from insect attacks or air-borne viruses from rodent manure (i.e. Hantavirus). Technicians should exercise caution when working inside the RASS transducer enclosure with the following guidelines:

- If rodent droppings are present inside the RASS enclosure, were a respirator with a HEPA filter while working inside the enclosure. Place rodent-poison inside the RASS enclosure to eliminate rodents.

- Inspect the inside of the RASS enclosure before entering, if wasps or hornets are present, use insecticide to eliminate them. Check the horn opening for evidence of insect nesting such and wasp nests.

9.5.2 Verify Calibration

Verifying the RASS amplifier calibration periodically can prevent false failure indications of RASS amplifier and transducers. See Section 9.4 for more information about RASS calibrations.

9.6 Remedial Maintenance

There are nine LRUs defined as part of the RASS system. Two of these LRUs, the RASS Signal Processor and the RASS Status Monitor are essentially standard LRUs modified for RASS operation.

Other RASS LRUs include: GPIB/RS-232 Controller, Sweep Generator, Power Supply Module, Audio Filter Module, Performance Monitor Module, Audio Power Amplifier, and transducer assemblies (Compression Drivers). Replacement is straight forward with no alignments necessary except when replacing the Audio Power Amplifier (see Section 9.4). LRU replacement procedures are described in the following sections.

9.6.1 GPIB/RS-232 Controller Replacement

1. De-energize RASS equipment circuit breaker at shelter power panel. Turn off GPIB controller.

2. Gain access to rear of RASS workbench by sliding workbench away from wall and removing four rear panel phillips head screws. Remove panel.

3. Disconnect power adapter cord, and remove.

4. Disconnect RS-232 cable (W301) and GPIB cable (W302) from rear of controller using flat head screw driver.

5. At front of cabinet remove four phillips head screws and slide controller tray out of cabinet.

6. Remove controller from controller tray by loosening two clip mounts on controller tray.

7. Obtain new RS-232/GPIB controller and power adapter cord.

8. Loosen two phillips head screws on rear of controller and slide circuit card/rear panel out from case of controller.

9. Verify DIP switch settings or circuit card.

   V20 = 01000101
   V22 = 01000101
   where 1 = ON, 0 = OFF

10. To install reverse removal procedure.

9.6.2 Sweep Generator Replacement

1. De-energize RASS equipment circuit breaker at shelter power distribution panel and turn off sweep generator.

2. Gain access to rear of sweep generator by sliding RASS electronics workbench away from shelter wall and remove four rear panel screws from workbench. Remove rear panel.

3. Disconnect AC power cord, "trigger in" (W300), GPIB cable (W302), and "function out" (W305) from rear of sweep generator using flat head screwdriver.

4. At front of RASS electronics workbench, remove sweep generator and front panel by removing four phillips head front panel mounting screws.

5. Remove front panels from sweep generator by removing four phillips head screws from angle bracket mounts on sweep generator.

6. Obtain new sweep generator.

7. To install reverse removal procedure.

9.6.3 15 VDC Power Supply Replacement

1. De-energize RASS equipment circuit breaker at shelter power distribution panel.

2. Using flat head screwdriver remove power supply module from subrack located in the RASS electronics workbench. Module slides out as screw is turned counter-clockwise.

3. Remove four phillips head screws from module rear panel and remove module rear panel.

4. Slide out and remove power supply circuit card.

5. Obtain new power supply circuit card.

6. To install reverse removal procedure.

9.6.4 Audio Filter Module Replacement

1. De-energize RASS equipment circuit breaker at shelter power distribution panel.

2. Using flat head screwdriver remove audio filter module from subrack located in the RASS electronics workbench. Module slides out as screw is turned counter-clockwise.

3. Remove four phillips head screws from module rear panel and remove module rear panel.

4. Slide out and remove audio filter circuit card.

5. Obtain new audio filter circuit card.

6. To install reverse removal procedure.

9.6.5 Performance Monitor Module Replacement

1. De-energize RASS equipment circuit breaker at shelter power distribution panel.

2. Using flat head screwdriver remove performance monitor module from subrack located in the RASS electronics workbench. Module slides out as screw is turned counter-clockwise.

3. Remove four phillips head screws from module rear panel and remove module rear panel.

4. Slide out and remove performance module circuit card.

5. Obtain new performance module circuit card.

6. To install reverse removal procedure.

9.6.6 Power Amplifier Replacement

1. De-energize RASS equipment circuit breaker at shelter power distribution panel. Turn off Power Amplifier.

2. Gain access to rear of RASS electronics workbench by sliding workbench away from shelter wall.

3. Remove workbench rear panel by removing four phillips head screws securing rear panel to workbench.

4. Disconnect AC power cord from power strip interior to workbench.

5. Disconnect LOW-Z-IN-A, LOW-Z-IN-B cables (W303 and W304) from rear of Power Amplifier.

6. Disconnect OUT-A-RED, OUT-A-BLK, OUT-B-RED, OUT-B-BLK (W306) fork lugs from rear of power amplifier.

7. Remove four phillips head mounting screws at power amplifier front panel.

8. Slide out and remove power amplifier assembly LRU.

9. Obtain new power amplifier assembly LRU.

10. Install by reversing removal procedure. DON'T power up power amplifier or RASS circuit breaker.

11. Verify both channels A and B are set to minimum output level (maximum attenuation) by using a flat head screwdriver on volume control located on of power amplifier front panel. Adjust these for full counter-clockwise position.

12. Verify rear panel settings of power amplifier are set to the following positions.

Channel A PL-2 out
Channel B PL-2 out
DAT enable
MODE stereo
Turn on power amplifier via front panel.

13. Energize RASS electronics circuit breaker at shelter power distribution panel.

14. Calibrate the RASS Power Amplifier using the procedures described in Section 9.4.

9.6.7 Pink Noise Generator Replacement

1. Gain access the RASS Workbench rear panel.

2. Unplug the Pink Noise Generator's AC power cord.

3. Disconnect the BNC Coaxial cable from the front panel of the Pink Noise Generator.

4. Install replacement Pink Noise Generator, connect the coaxial cable to the front panel and plug the AC power cord in.

9.6.8 Transducer Assembly Replacement

1. Locate inoperable transducer by listening to each transducer enclosure assembly during the RASS sounding period (Vertical beam)

2. De-energize RASS electronics circuit breaker at shelter power distribution panel.

3. De-energize RASS heater circuit breakers at shelter power distribution panel.

4. Enter antenna field and gain access to RASS transducer assembly by removing access hatch.

5. Enter RASS transducer assembly and remove horn enclosure assembly cover.

6. Remove old transducer (compression driver) by un-bolting four mounting screws attaching compression driver to horn enclosure assembly.

7. Obtain new transducer (compression driver).

8. To install reverse removal procedure.

10 Surface Meteorological Observing Systems

All NOAA Profiler Network (NPN) site are equipped with one-of-two styles of surface meteorological observing systems. The first system, referred to as PSOS (Profiler Surface Observing System), is installed at 14 network sites. The second system, referred to as GSOS (GPS Surface Observing System) is installed at the remaining 20 network sites. Figure 10-1 shows the distribution of PSOS and GSOS at NPN sites. Refer to Section 10.1 for information about PSOS and Section 10.2 for information about GSOS.

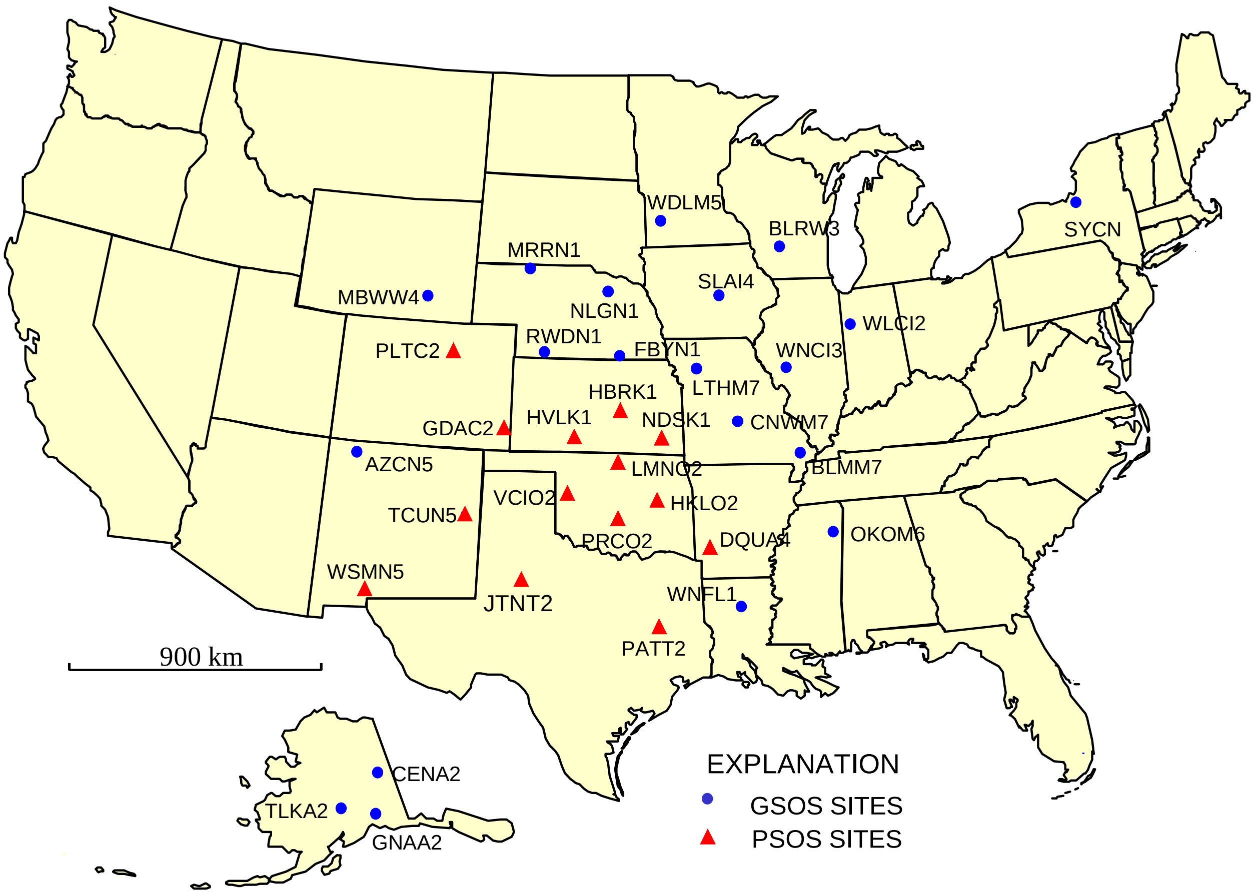


Figure 10-1 NPN Surface Meteorological Payload Distribution

10.1 Profiler Surface Observing System (PSOS)

PSOS was the first generation meteorological acquisition system, and has been in-use at profiler sites since 1991. However, due to the cost of the PSOS systems, only 14 sites were targeted for installation. PSOS provides measurements for surface winds, air temperature, dewpoint/relative humidity, precipitation, and barometric pressure.

10.1.1 PSOS System Description

10.1.1.1 MARS Payload

The MARS (Multifunction Acquisition and Reporting System) payload is comprised of a CPU, sensor interface modules, and a modem, all housed in a NEMA 4X enclosure. The MARS payload is located inside the profiler shelter, mounted in the wall to the right of the Power Amplifier Cabinet (see Figure 10-2).

10.1.1.2 Junction Box

The Junction Box mounted on the wall next to the MARS enclosure houses the MARS DC power supply and barometric pressure sensor (see Figure 10-2). Terminal blocks inside the junction box provide terminations for external sensor cables.

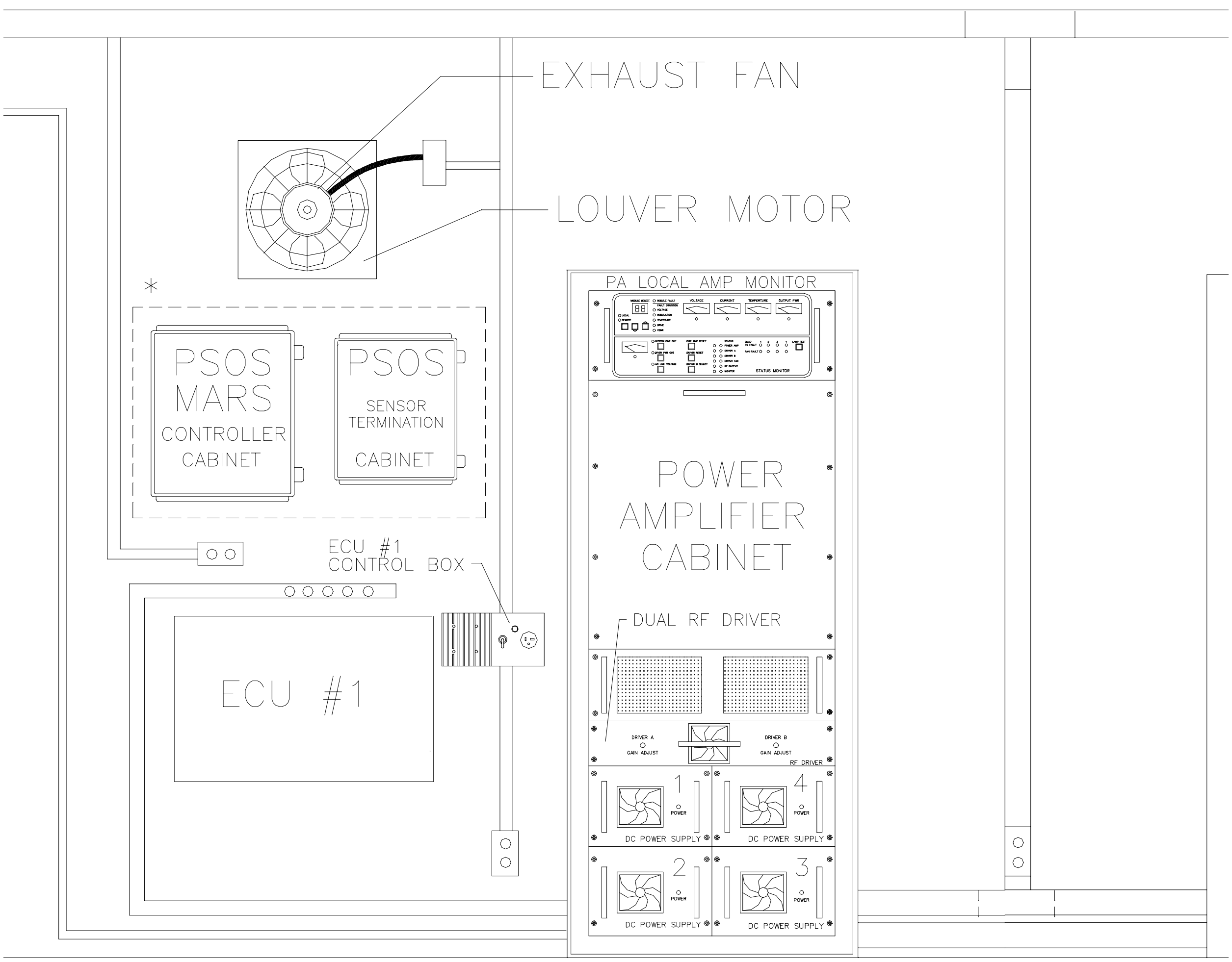


Figure 10-2 Location of PSOS Electronics in Profiler Shelter

10.1.1.3 Fold-Over Mast Assembly and Sensors

The Fold-Over Mast provides mounting for PSOS exterior sensors (anemometers, air temperature sensor, and dewpoint/relative humidity sensor). The mast is 10 meters in length and is counter balanced at the base (see Figure 10-3). The pivot design allows the mast to be lowered and raised by one man. The mast is secured in the vertical position with two shackles at the base of the mast.

Two RM Young anemometers are mounted to a cross-member at the top of the mast. The air temperature sensor, dewpoint sensor, and barometric pressure port are mounted on a cross-member on the lower section of the mast.

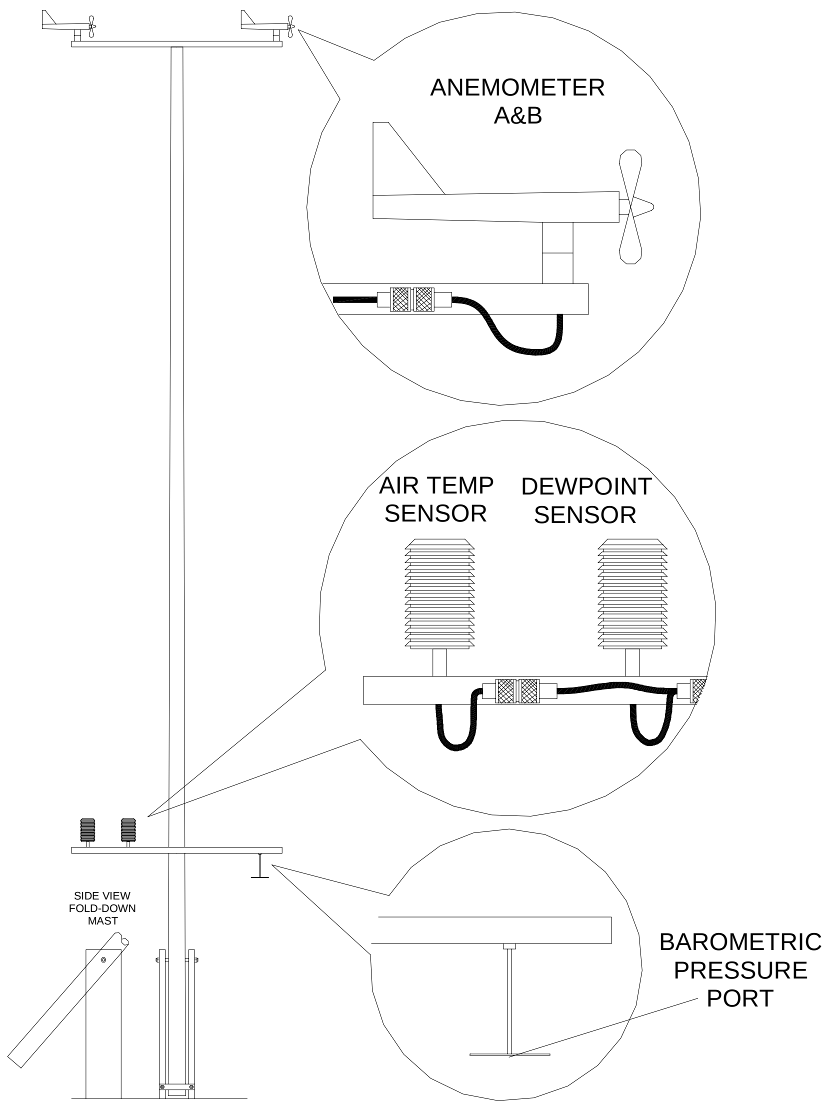


Figure 10-3 PSOS Fold-Over Mast and Sensors

10.1.1.4 Rain Gage

The Rain Gage is a heated tipping-bucket rain gage, located inside the profiler compound fence near the shelter (see Figure 10-4). The heating element requires 120 VAC and is controlled by a thermostat inside the rain gage assembly.

The funnel (the top half of the assembly) is removable, providing access the tipping mechanism and wiring terminations.

Figure 10-4 Rain Gage

10.1.2 Operations

The MARS controller is a polled device, meaning it does not transmit any data unless it receives a request from the host computer. When power is first applied to the MARS payload, it does not begin sampling until it received a poll character from the host computer system. The first response to a poll sent from the MARS payload after the application of power is message stating the “MARS is On-Line”. Six minutes later, if another poll character is received by the MARS, it transmits a 36-character string containing the latest data samples.

The PSOS reports dewpoint measurements, but the sensor used is not a dewpoint sensor, it is a relative humidity (RH) sensor. The MARS uses an algorithm to derive dewpoint measurement from the air temperature sensor and RH sensor data.

The PSOS barometer measures *station* pressure and MARS calculates *sea-level* pressure. The algorithm requires current *station* barometric pressure and air temperature readings and an air temperature reading from 12 hours earlier to derive a *sea-level* pressure reading. Once power is applied to the PSOS payload (or if the PSOS is power-cycled or loses power) it takes 12 hours of continuous operation before *sea-level* pressure readings will be available.

10.1.2.1 PSOS Communications Interface

The MARS payload communicates with profiler Data Processor via an RS232 interface. The communications cable from the MARS (DB25 Female) plugs into port C1 on the rear panel of the Data Processor (see Figure 4-14). Serial communications parameters for the MARS payload are:

Baud Rate:	1200
Data Bits:	8
Stop Bits:	1
Parity:	No
Flow Control:	None

The Data Processor polls the PSOS every 6 minutes during the radar's vertical low mode by sending the PSOS an ASCII "L" character. When PSOS receives a poll-character, it transmits a 36-byte string containing the latest 6-minute data samples.

10.1.2.1.1 Configuring the Data Processor to interface with GSOS

Several of the Data Processor's setup parameters must be configured to accept PSOS data. The Profiler Maintenance Terminal (PMT) provides the means to modify these parameters.

1. Connect the PMT interface cable to the DB25 connector on the front panel of the Status Monitor. Start the PMT program on the notebook computer and login to the wind profiler system.

2. Using the Profiler Maintenance Terminal (PMT), place the profiler into *Maintenance Mode*.

3. Select *System Parameters* for the PMT *Main Menu* options.

4. Select *Communications* from the *System Parameters Menu*. The following screen is displayed on the PMT (see Figure 10-5). Use the arrow keys to move cursor to the desired field. Press the *F5* key to select the field. Modify the field as required, and commit the change to the field by pressing the *F6* key.

```
3 WPS-234, PASSWORD REQUIRED                          Maintenance
4 This could take 6 minutes
5 COMMAND EXECUTED
                   Communications Parameters Menu

 Communication Method          BOTH            Landline, Goes, Both

 Goes Id                       750126DA        00000000-FFFFFFFE Hex
 Channel Number                 93             001-199 Decimal
 Transmission Minute            7              00..59
 Transmit Frequency            1               1..6
 Preamble Length               S               S[hort] or L[ong]
 Vertical Parity               Y               Yes or No

 Landline Parameters
 Landline Baud Rate            1200            0300,1200,2400,4800,9600
 x/ON x/OFF Enable             N               Yes or No
 Radiometer Data Inc.          Y               Yes or No
 Radiometer Data Block Length  036             002 to 512 - Even number

 Radiometer Baud Rate          1200            0300,1200,2400,4800,9600



1 Prev  2       3       4       5 select 6Enter  7     8     9      0
```

Figure 10-5 PMT Communications Parameters Menu

5. Set ***Radiometer Data Inc***. = *Y*. This informs to Data Processor that a PSOS unit is connected to port C1, and to poll the PSOS every 6-minutes.

6. Set ***Radiometer Data Block Length*** = *036*. This tells the Data Processor how many bytes of data to expect to be received from the PSOS.

7. Set ***Radiometer Baud Rate*** = *1200*. The baud rate must match the PSOS serial Port baud rate.

8. Return the profiler to *Operational* Mode.

10.1.2.1.2 Verifying the Data Processor is receiving data from PSOS

If the Data Processor parameters are configured to expect Radiometer Data (PSOS), the Data Processor will transmit as ASCII “L” character to the PSOS during the vertical low mode of the radar’s 6-minute cycle. If the PSOS fails to send a response back to the Data Processor, an *AUXILIARY DEVICE* fault is generated and placed in the radar’s Failure Data Log (the Failure Data Log is viewed using the PMT).

The data received from PSOS can be viewed using the PMT Radiometer Data Display. Select *Display Current Output* from the PMT *Main Menu*, select *Landline*, then *Radiometer Data*. A display similar to Figure 10-6 will appear on the PMT screen. The 36-byte ASCII string received from the GSOS is displayed as 1-byte hexadecimal values, refer to Table 10-1 for a Hexadecimal to ASCII Conversion Chart. If all 36 bytes are “00”, then no response string was received from the PSOS

```
3 WPS-234, PASSWORD REQUIRED                          Operational
4 This could take 6 minutes
5 COMMAND EXECUTED
                          Radiometer Data

 Mode: 03  Submode: 01          Length 0192      Checksum: 5A6E

                           Radiometer Data

    001..010   01 02 03 04 05 06 07 08 09 0A
    011..020   0B 0C 00 01 02 03 04 05 06 07
    021..030   08 09 0A 0B 0C 00 01 02 03 04
    031..036   05 06 OA 0A 0A 0B

                                                                      Prev     Next
1 Prev  2       3       4       5        6       7     8     9Screen 0Screen
```

Figure 10-6 PMT - Landline Output - Radiometer Data

Table 10-1 Hexadecimal to ASCII Conversion Chart

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00	Null	32	20	Space	64	40	@	96	60	‘
1	01	Start of heading	33	21	!	65	41	A	97	61	a
2	02	Start of text	34	22	“	66	42	B	98	62	b
3	03	End of text	35	23	#	67	43	C	99	63	c
4	04	End of transmit	36	24	$	68	44	D	100	64	d
5	05	Enquiry	37	25	%	69	45	E	101	65	e
6	06	Acknowledge	38	26	&	70	46	F	102	66	f
7	07	Audible bell	39	27	‘	71	47	G	103	67	g
8	08	Backspace	40	28	(	72	48	H	104	68	h
9	09	Horizontal tab	41	29	)	73	49	I	105	69	i
10	0A	Line feed	42	2A	*	74	4A	J	106	6A	j
11	0B	Vertical tab	43	2B	+	75	4B	K	107	6B	k
12	0C	Form feed	44	2C	,	76	4C	L	108	6C	l
13	0D	Carriage return	45	2D	-	77	4D	M	109	6D	m
14	0E	Shift out	46	2E	.	78	4E	N	110	6E	n
15	0F	Shift in	47	2F	/	79	4F	O	111	6F	o
16	10	Data link Escape	48	30	0	80	50	P	112	70	p
17	11	Device Control 1	49	31	1	81	51	Q	113	71	q
18	12	Device Control 2	50	32	2	82	52	R	114	72	r
19	13	Device Control 3	51	33	3	83	53	S	115	73	s
20	14	Device Control 4	52	34	4	84	54	T	116	74	t
21	15	Neg. acknowledge	53	35	5	85	55	U	117	75	u
22	16	Synchronous idle	54	36	6	86	56	V	118	76	v
23	17	End trans. ack	55	37	7	87	57	W	119	77	w
24	19	Cancel	56	38	8	88	58	X	120	78	x
25	19	End of medium	57	39	9	89	59	Y	121	79	y
26	1A	Substitution	58	3A	:	90	5A	Z	121	7A	z
27	1B	Escape	59	3B	;	91	5B	[	123	7B	{
28	1C	File separator	60	3C	<	92	5C	\	124	7C	|
29	1D	Group separator	61	3D	=	93	5D	]	125	7D	}
30	1E	Record separator	62	3E	>	94	5E	^	126	7E	~
31	1F	Unit separator	63	3F	?	95	5F	_	127	7F	

10.1.2.2 Communicating with the PSOS using a Terminal

For troubleshooting purposes, a computer (running a terminal emulation program) can be connected to the PSOS communications interface cable (the cable that connects to port C1 on the Data Processor rear panel. See Figure 4-14.) See Section 10.1.2.1 for serial port communications settings. The user can send ASCII poll-characters to the PSOS and the response is printed on the terminal screen. Typing an ASCII “L” character should produce a response similar to the example shown below.

```
PLTC23591023581040280080298091052033
sssssaaabbbAAABBBztttZTTTppppLLLLrrr
123456789012345678901234567890123456
         1         2         3

where:   sssss = site name or ID.
           aaa = Anemometer A Wind Direction 000-359 degrees
           bbb = Anemometer A Wind Speed 00.0-99.9 m/s
           AAA = Anemometer B Wind Direction 000-359 degrees
           BBB = Anemometer B Wind Speed 00.0-99.9 m/s
             z = Air Temperature sign 0=+, 1=-
           ttt = Air Temperature -99.9 - +99.9 in derees C
             Z = Dewpoint Temperature sign 0=+, 1=-
           TTT = Dewpoint Temperature -99.9 - +99.9 degrees C
          pppp = station barometric pressure in millibar.
                 000.0 - 999.9 mb
                 (numbers less than 100.0 are interpreted as
                  values ppp.p + 1000 mb)
          LLLL = Sea-Level (derived) Barometric Pressure in millibar.
                 000.0 - 999.9 mb
                 (numbers less than 100.0 are interpreted as
                  values ppp.p + 1000 mb)
           rrr = Precipitation 00.0 - 99.9 mm/6-minute
```

10.1.3 Replacement Procedures

The following tools are required to and replace PSOS components:

- #2 Phillips Head Screwdriver
- #2 Flat Blade Screwdriver
- Small Flat Blade Screwdriver
- Diagonal Cutters/Utility Knife
- Electrical Tape or self-vulcanizing tape
- 2 - 3/4” Adjustable Wrench (Crescent Wrench) or
- 3/4”, 5/8”, 9/16”,1/2”, and 5/16” Open-end Wrenches
- Step Ladder

10.1.3.1 Payload Replacement

1. Turn off the AC power to the PSOS electronics by unplugging the AC power cable from the uninterruptible power supply (UPS).
2. Disconnect the interface cables from the bottom of the MARS payload enclosure.
3. Loosen and remove four nuts from the MARS enclosure’s mounting bolts.
4. Remove the MARS payload enclosure from the wall.
5. Mount the replacement MARS enclosure to the wall and secure the four fasteners.
6. Connect the interface cables to the appropriate connectors on the bottom of the MARS enclosure.
7. Connect the AC power cord the UPS.
8. Verify proper operation of the new MARS payload. Refer to “Operations” in Section 10.1.2

10.1.3.2 Barometric Pressure Sensor Replacement

1. Turn off the AC power to the PSOS electronics by unplugging the AC power cable from the uninterruptible power supply (UPS).
2. Open the door on the junction box mounted next the MARS enclosure.
3. Note the terminal block locations of the pressure sensor’s interface wires and disconnect the wires from the terminal block.
4. Remove the pressure sensor’s mounting hardware and remove sensor from enclosure.
5. Install and secure the replacement pressure sensor.
6. Connect the sensor’s interface wires to the terminal block.
7. Close the door on the junction box.
8. Connect the AC power cord the UPS.

9. Verify proper operation of the new pressure sensor. Refer to “Operations” in Section 10.1.2

10.1.3.3 Anemometer Replacement

1. Turn off the AC power to the PSOS electronics by unplugging the AC power cable from the uninterruptible power supply (UPS).

2. Disconnect the fold-over mast’s ground wire from the grounding rod.

3. Carefully lower the PSOS fold-over mast. The mast can be propped-up off the ground using the chair the from the profiler shelter

4. Identify anemometer A or B from markings on the cross-member or cable labels.

5. Carefully remove the weather-seal from the interface anemometer’s connector and disconnect the cable.

6. Remove the failed anemometer and install the replacement unit.

7. Connect the anemometer’s interface cable and seal connection with electrical tape or self-vulcanizing tape.

8. Raise and secure the fold-over mast in the vertical position.

9. Connect the mast’s ground wire to the grounding rod.

10. Connect the AC power cord the UPS.

11. Verify proper operation of the anemometer. Refer to “Operations” in Section 10.1.2

10.1.3.4 Temperature Sensor or Dewpoint Sensor Replacement

1. Turn off the AC power to the PSOS electronics by unplugging the AC power cable from the uninterruptible power supply (UPS).

2. The temperature and dewpoint sensors are mounted on a cross member on the lower portion of the fold-over mast. Use a ladder or fold the mast over to gain access the these sensors.

3. Identify temperature or dewpoint sensors by cable markings or connector style.

4. Carefully remove the weather-seal from the sensor's interface connector and disconnect the cable.

5. Remove the failed sensor and install the replacement unit.

6. Connect the sensor's interface cable and seal connection with electrical tape or self-vulcanizing tape.

7. If the mast was lowered, raise and secure the mast in the vertical position. Connect the mast's ground wire to the grounding rod.

8. Connect the AC power cord the UPS.

9. Verify proper operation of the temperature or dewpoint sensor. Refer to "Operations" in Section 10.1.2

10.1.3.5 Rain Gage Replacement

1. Turn off the AC power to the PSOS electronics and the rain gage by unplugging the AC power cable from the uninterruptible power supply (UPS) and de-energizing the PSOS circuit breaker at the power distribution panel.

2. The rain gage is located in the profiler antenna compound. Disable the radar transmitter by placing the profiler in *Maintenance* mode prior to entering the antenna compound.

3. Remove the top section of the rain gage to gain access the wiring terminations.

4. Disconnect the AC power wires for the rain gage heater and the sensor interface wiring.

5. Remove the rain gage base assembly from the mounting tripod.

6. Remove the top section from the replacement rain gage. Install the new base assembly in the tripod and secure in position.

7. Connect the interface wires and AC power wiring inside the base assembly.

8. Install the top section of the rain gage and secure in position.

9. Power-up the PSOS electronics and energize the PSOS breaker to restore power to the rain gage heater.

10. Use the PMT to place the profiler in *Operational* mode

11. Wait at least 6-minutes to allow the radar to cycle though the vertical beam. Verify proper operation of the rain gage by pouring some water through the rain gage and verify rain gage tips were registered. Refer to “Operations” in Section 10.1.2

12. Close the antenna field access door (or antenna fence access gate if used).

13. Use the PMT to *Reset Access Alarms Immediate* from the *Status Monitor Reset* menu. Reboot the profiler by selecting System Reboot from the Systems Operations menu.

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10.2 GPS Surface Observing System (GSOS)

The GPS Surface Observing System (GSOS) is a low-cost meteorological data acquisition system originally designed to provide barometric pressure, air temperature and humidity measurements required by the GPS-IPW Observing System to calculate water vapor measurements (see Figure 10-7). GSOS was developed through a joint effort between the Forecast Systems Laboratory (FSL) and the National Data Buoy Center (NDBC). NDBC manufactures the GSOS assemblies, serves as the repair facility, and provides depot support for GSOS components. Some of the GSOS key features are:

Designed using COTS Components	GSOS system components are commercial off-the-shelf parts.
Wide Operational Temperature Range	-40^{o} C to +40^{o} C operational temperature range.
All Digital Sensors	High quality digital sensors manufactured by Vaisala.
Expandible Architecture	Expandable architecture allows anemometer and precipitation sensors to be added to the base configuration.
Flexible Communications Options	Communication interface options include RS422/RS485 or RS-232.
Several Mounting Options	Mounting hardware allows the Payload to be affixed to a variety of fence post diameters or rhone towers.
Fold-down Arm	Fold-down arm provides easy access to sensors for maintenance or replacement.

Figure 10-7 GSOS Payload Assembly

10.2.1 System Description

As shown in Figure 10-8, GSOS consists of two primary assemblies; the Payload, and the Power Supply and Communications Interface. The payload communication interface is RS-485/RS-422, which allows the power supply and communications interface to be located up to 4000 feet from the payload. The transducers are self contained digital sensor/transmitters that communicate with the controller via RS-485 and RS-232 interfaces. The interface between the payload and power supply and communications interface is protected by two surge suppression devices.

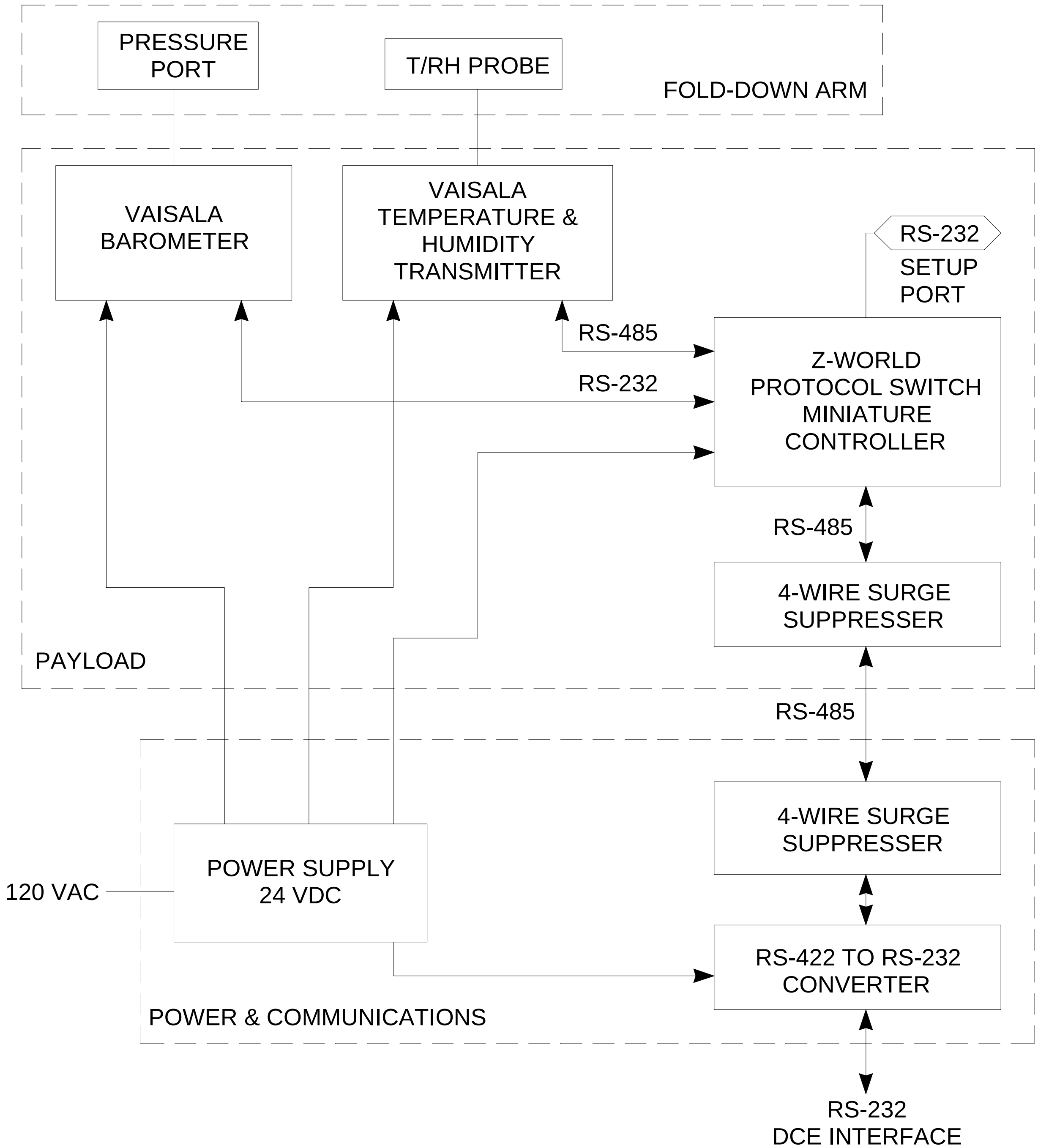

Figure 10-8 GSOS Block Diagram

10.2.1.1 Payload

The GSOS Payload electronics are housed in a Hoffman NEMA 4X enclosure containing a four-slot card cage and interconnection panel (see Figure 10-9). The electronic components housed in the enclosure consist of a 4-wire communications surge suppressor, micro controller, barometric pressure sensor, and an integrated temperature/humidity sensor. Each component is mounted on a removable shelf for easy access and replacement. Figure 10-10 provides a detailed wiring schematic for the GSOS Payload Assembly. All payload interface connection are located on the bottom of the enclosure as shown in Figure 10-11

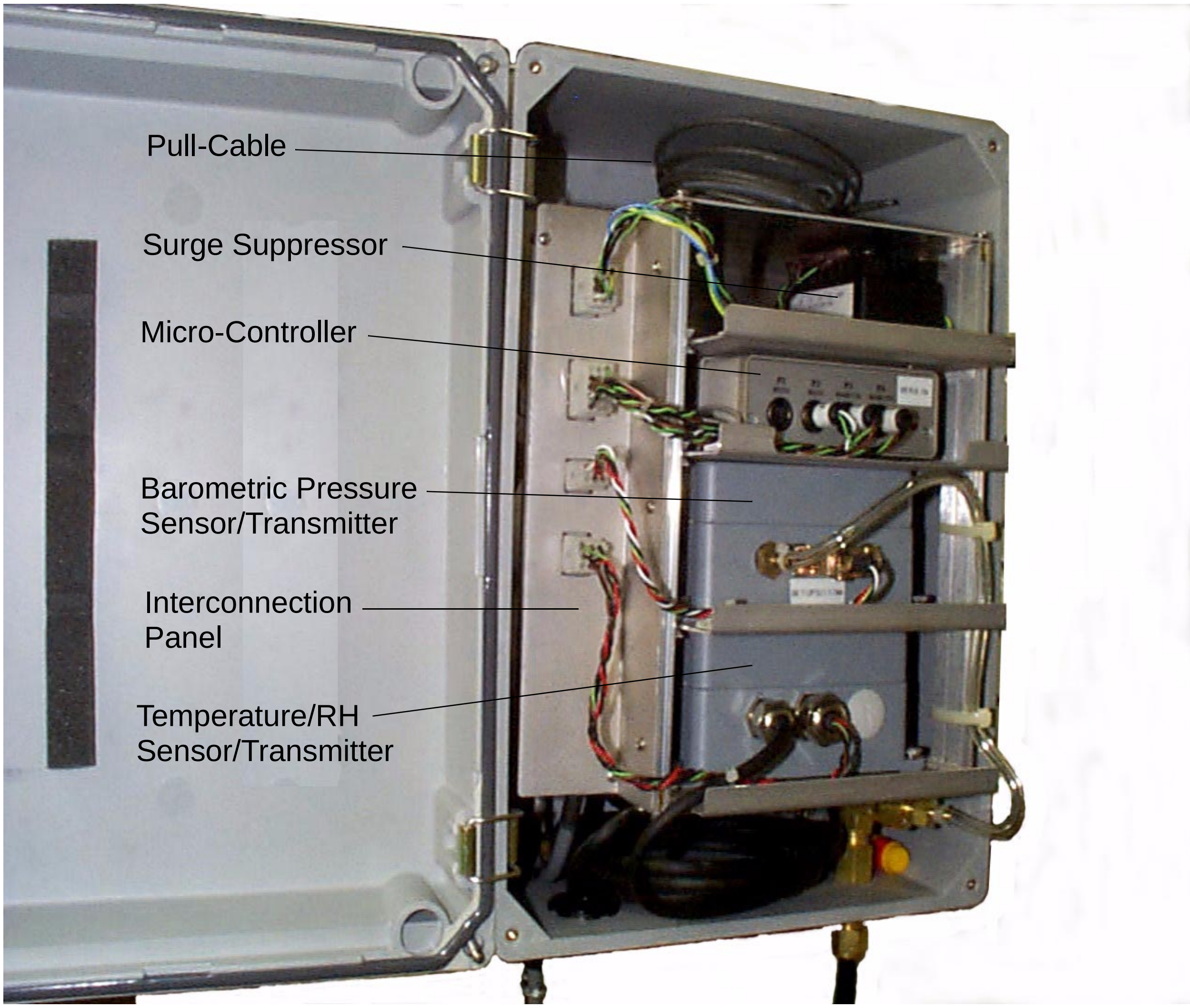

Figure 10-9 GSOS Payload Electronics Assembly

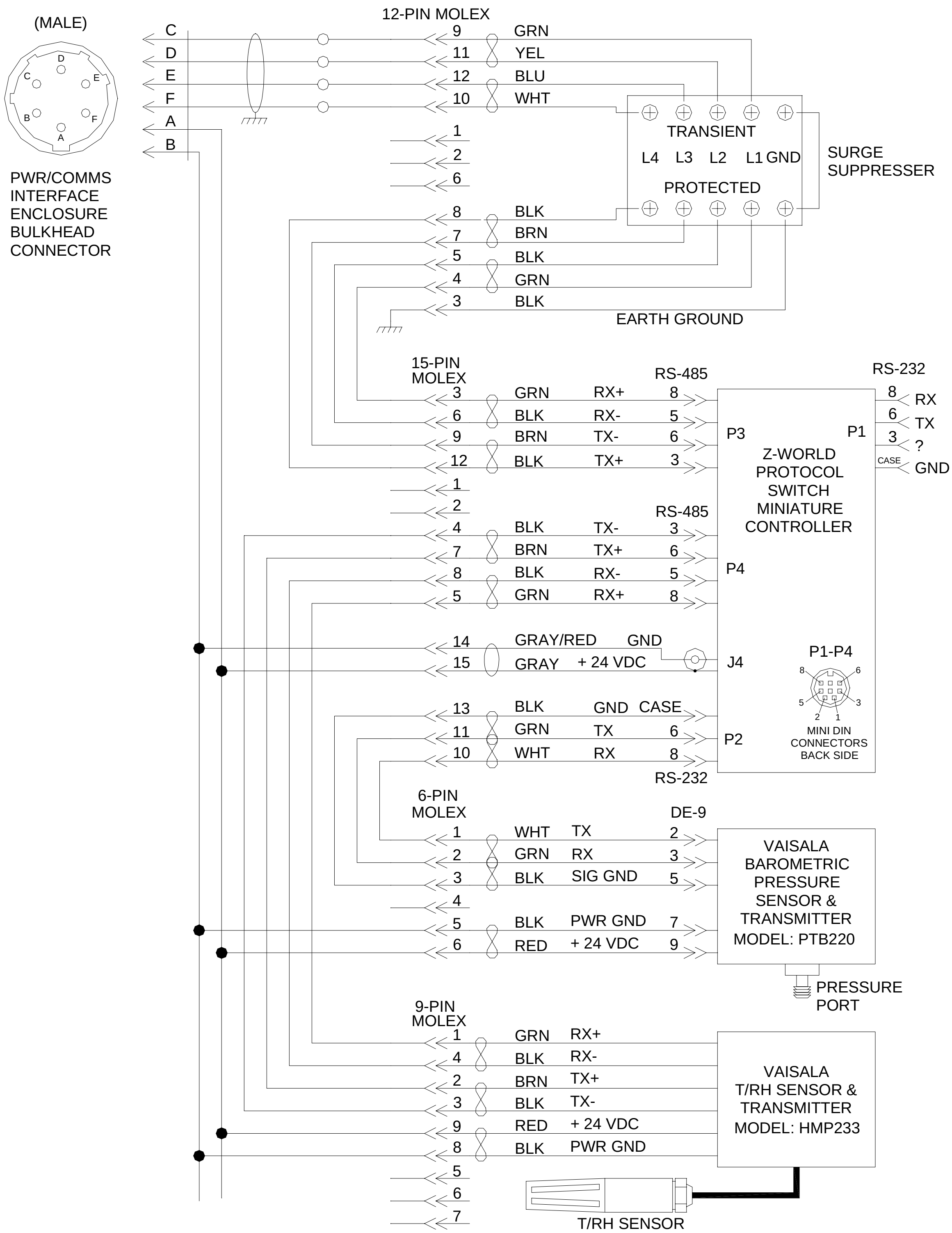

Figure 10-10 GSOS Payload Wiring Schematic

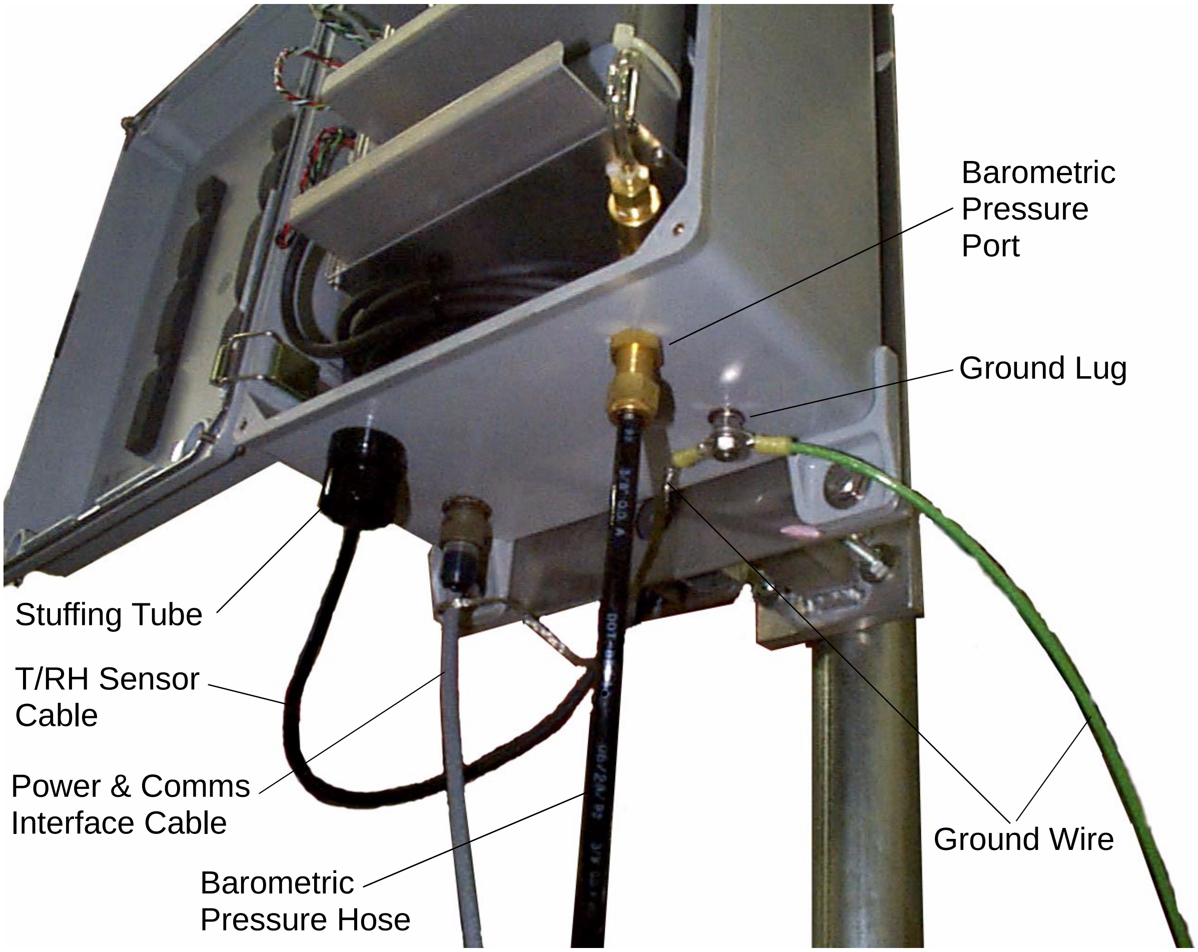

Figure 10-11 GSOS Payload Interfaces

10.2.1.1.1 Controller Assembly

The GSOS Controller Assembly is a Z-World model BL1300 Protocol Switch Micro-Controller build around the 9 MHz Z180 micro-processor chip. The controller has a built-in Real-Time Clock and Watch-Dog Reset Timer. The controller has two RS232 serial ports (P1 and P2) and two serial port (P3 and P4) that can be configured as RS485/ RS422 or RS232 (see Figure 10-12). The controller is equipped with sufficient SRAM to store 7-days of data at 5-minute intervals. However, should the controller lose power, all data samples will be lost. Critical site specific parameters are stored in non-volatile memory and are un-affected by loss of power. The DC power input connector is located on the controller rear panel (see Figure 10-13) is labeled as *+9 VDC*. However, the controller will operate with any DC supply voltage between 9 VDC and 36 VDC.

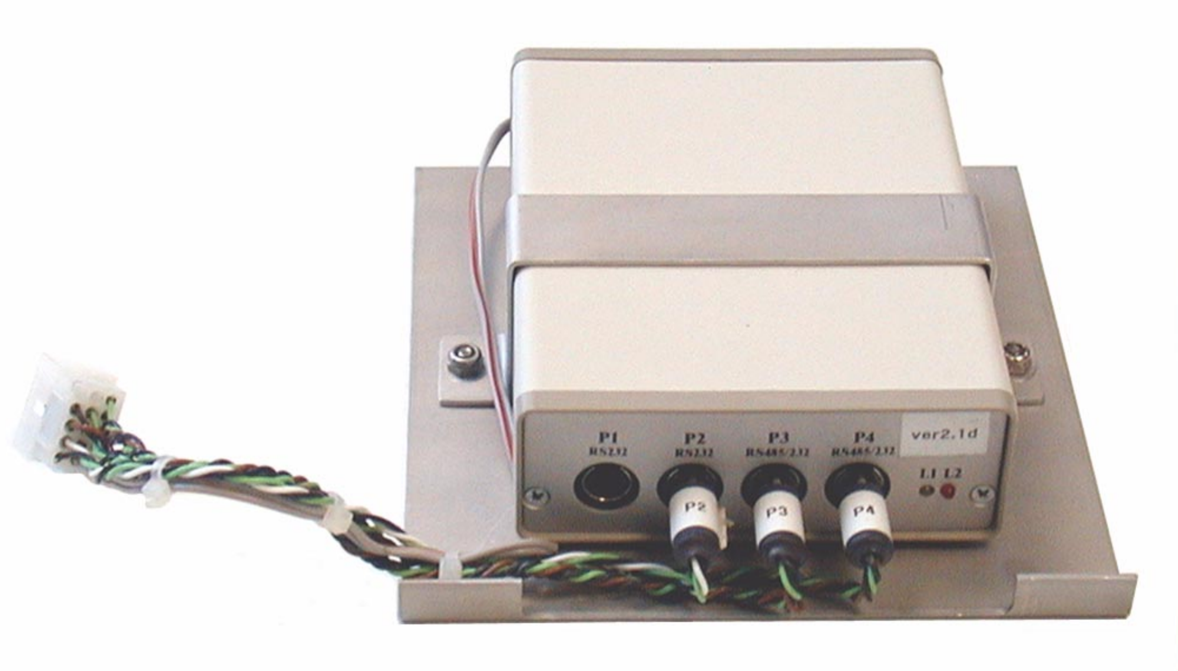

Figure 10-12 GSOS Controller Assembly Front View

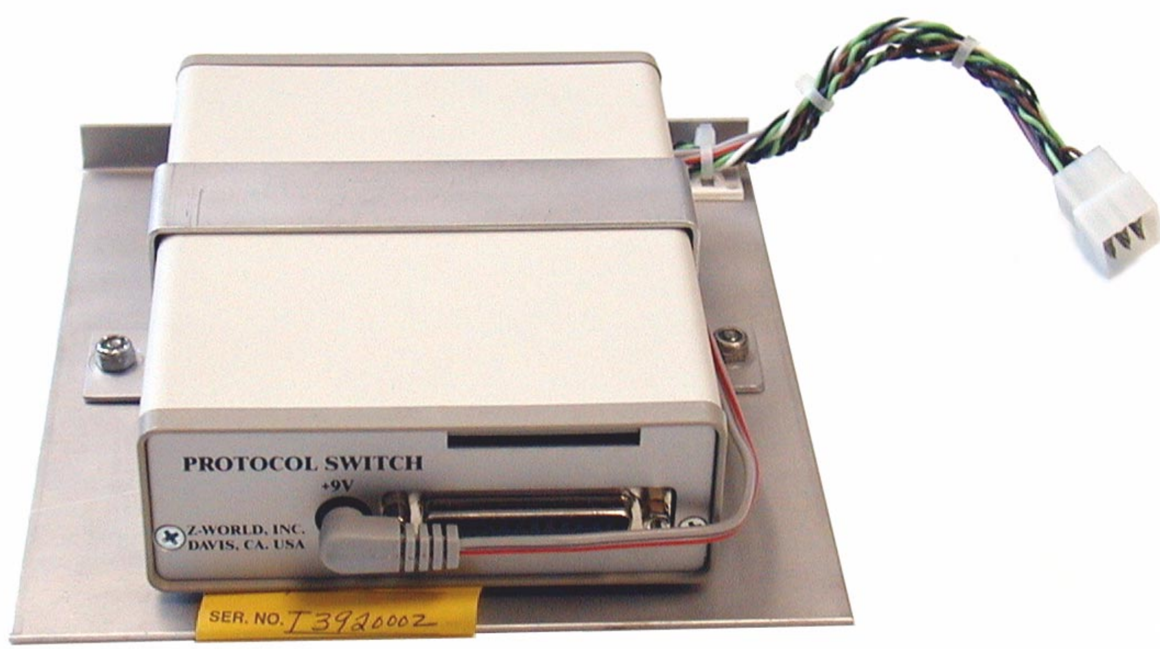

Figure 10-13 GSOS Controller Assembly Rear View

10.2.1.1.2 Barometric Pressure Sensor-Transmitter Assembly

The pressure sensor is a *Vaisala PTB220 Series Digital Barometer* (see Figure 10-14). This barometer has excellent hysteresis and repeatability characteristics and outstanding temperature and long-term stability. The barometer communicates with the GSOS Controller via RS232 interface. The barometer's key specifications are shown below:

Pressure Range	500 ... 1100 hPa
Temperature Range	-40 ... +60 ^{o}C
Total Accuracy	$\pm$0.25 hPa
Long-term Stability	$\pm$0.1 hPa/year
Supply Voltage	10 ... 30 VDC

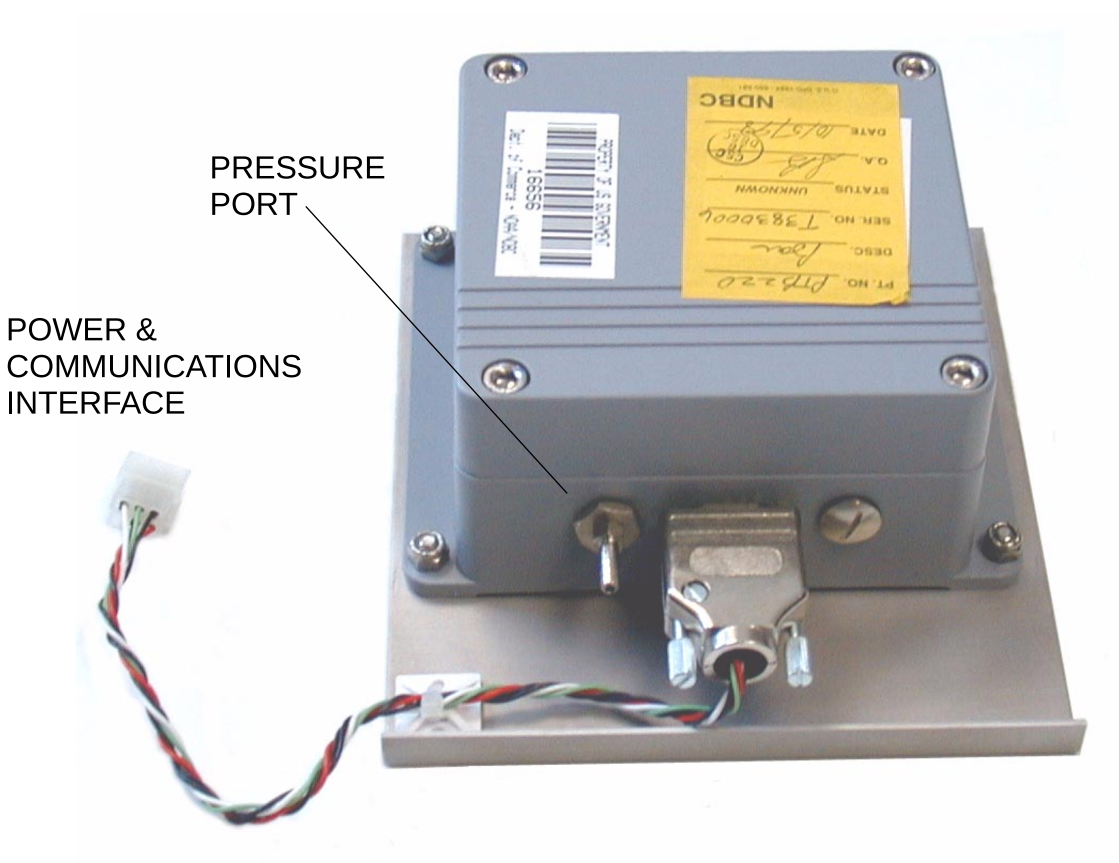

Figure 10-14 Barometric Pressure Sensor-Transmitter Assembly

10.2.1.1.3 Temperature/Relative Humidity Sensor-Transmitter Assembly

The Temperature/Relative Humidity (T/RH) Sensor is a *Vaisala Model HMP233*. As shown in Figure 10-15, the sensor probe and the transmitter unit are integrated into one assembly. If either the probe or transmitter fails, the entire assembly is replaced. The T/RH assembly communicates with the GSOS Controller via RS485/RS422 interface.

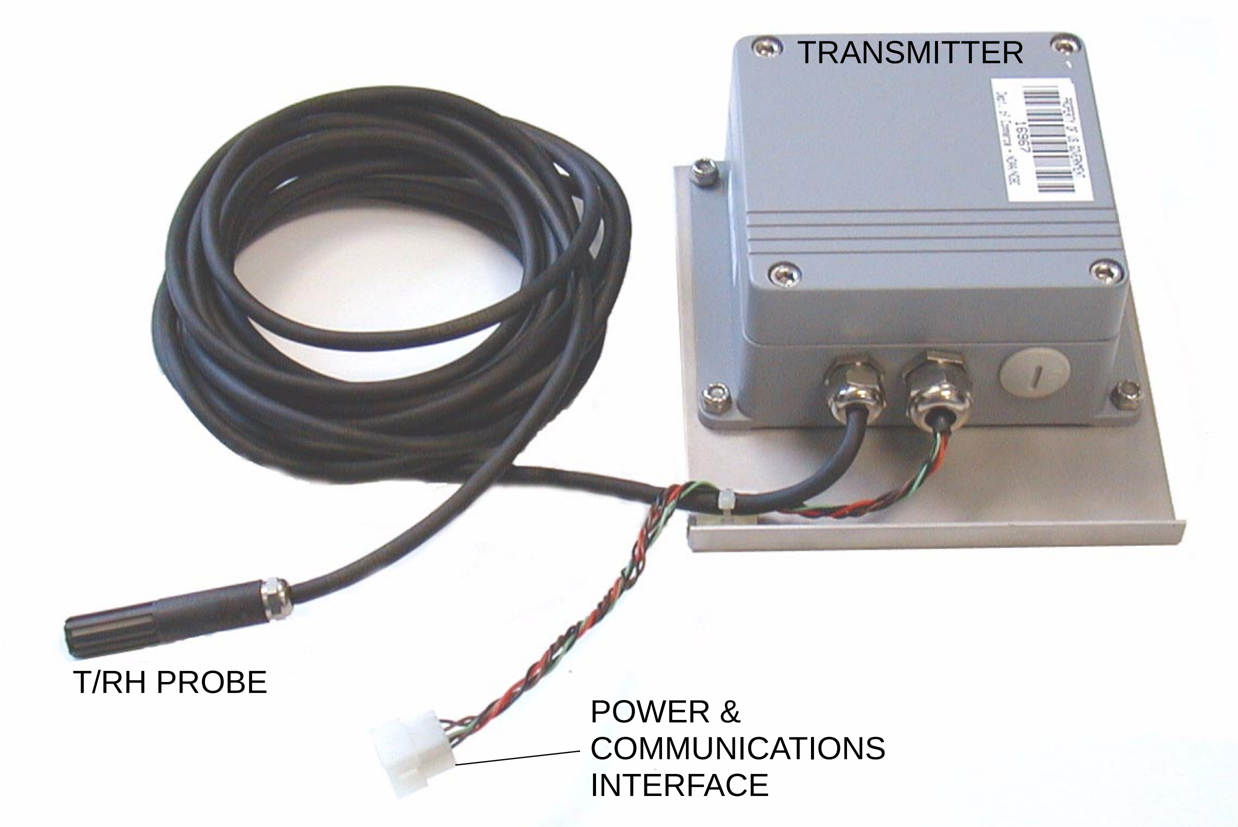

Figure 10-15 T/RH Sensor-Transmitter Assembly

10.2.1.1.4 Surge Suppressor Assembly

This Surge Suppressor Assembly is an *Amber Industries Model 1148-12* (see Figure 10-16). The suppressor provides two-stage protection for 4-wire communications circuits, dissipating both positive and negative voltage transients. The model 1148-12 specifications are show below:

Operating Voltage:	±12 Vpk
Let-through Voltage:	±24v (l-g)
Series Resistance:	10 Ohms
Max. Transient Voltage:	10 KV (8 x 20 microseconds)
Mix. Transient Current:	20 KA/line (8 x 20 microseconds)
Response Time:	less than 5 microseconds

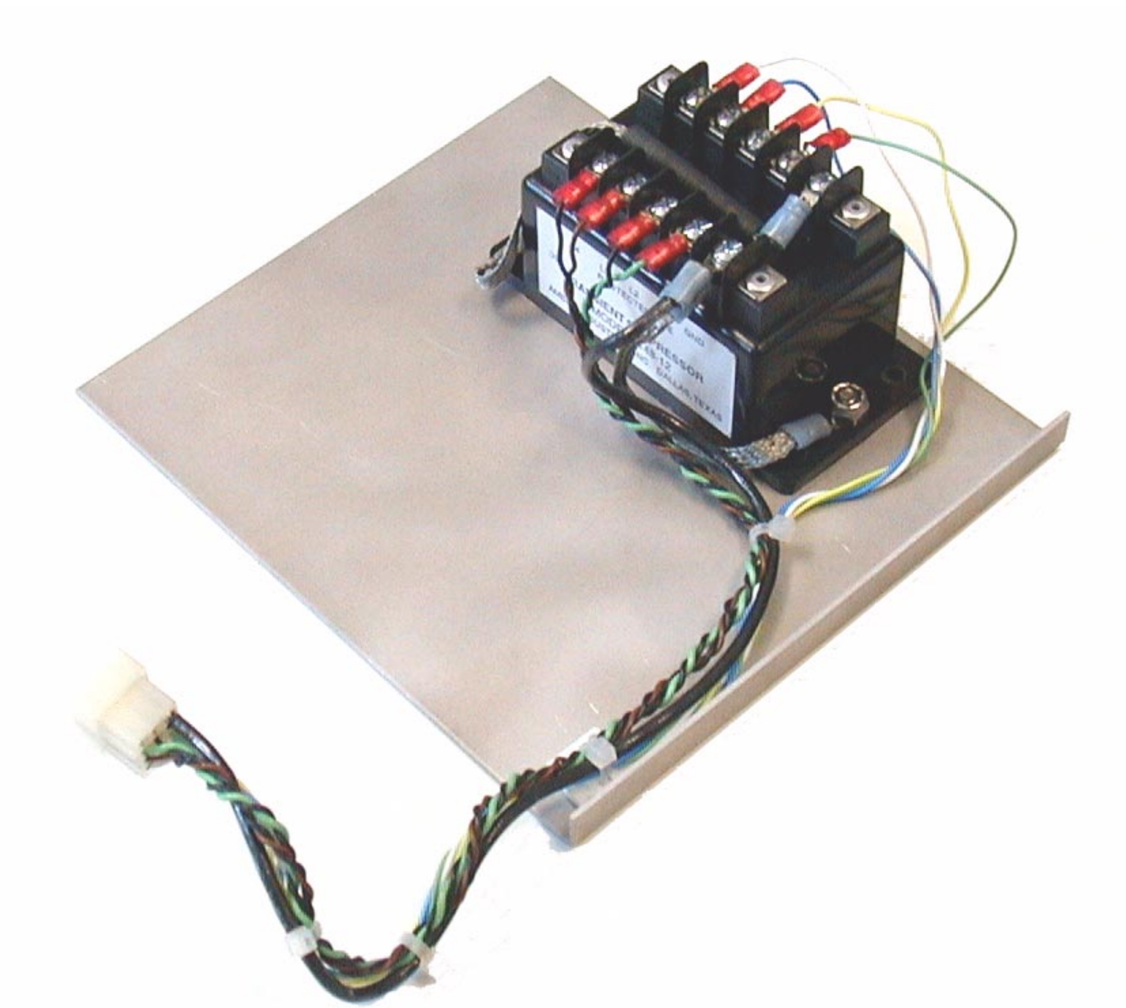

Figure 10-16 Surge Suppressor Assembly

10.2.1.2 Mounting Assembly and Fold-Down Arm

The GSOS Mounting Assembly attaches to one of the fence posts surrounding the profiler antenna compound (see Figure 10-17). The fold-down arm is hollow and serves as conduit to route the barometric pressure hose and T/RH sensor cable to the top of arm. The Fold-down arm is held in the vertical position by a Cotter Pin.

At the top of the fold-down arm, a radiation shield surrounds the T/RH sensor probe to protect it from the elements (see Figure 10-18). The metallic disk below the radiation shield is the barometric pressure port opening.

The gray PVC tube shown in Figure 10-18 provides the mounting mechanism for the T/RH probe. The PVC tube can be removed from the aluminum cube by loosening the thumb screw and pulling the PVC tube out from the bottom.

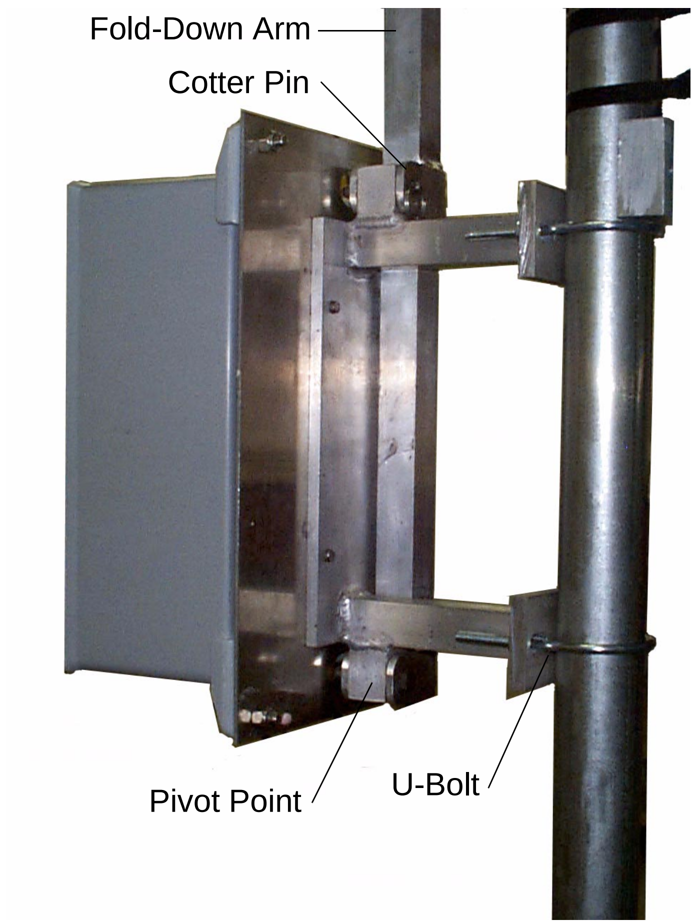

Figure 10-17 GSOS Mounting Assembly and Fold-Down Arm

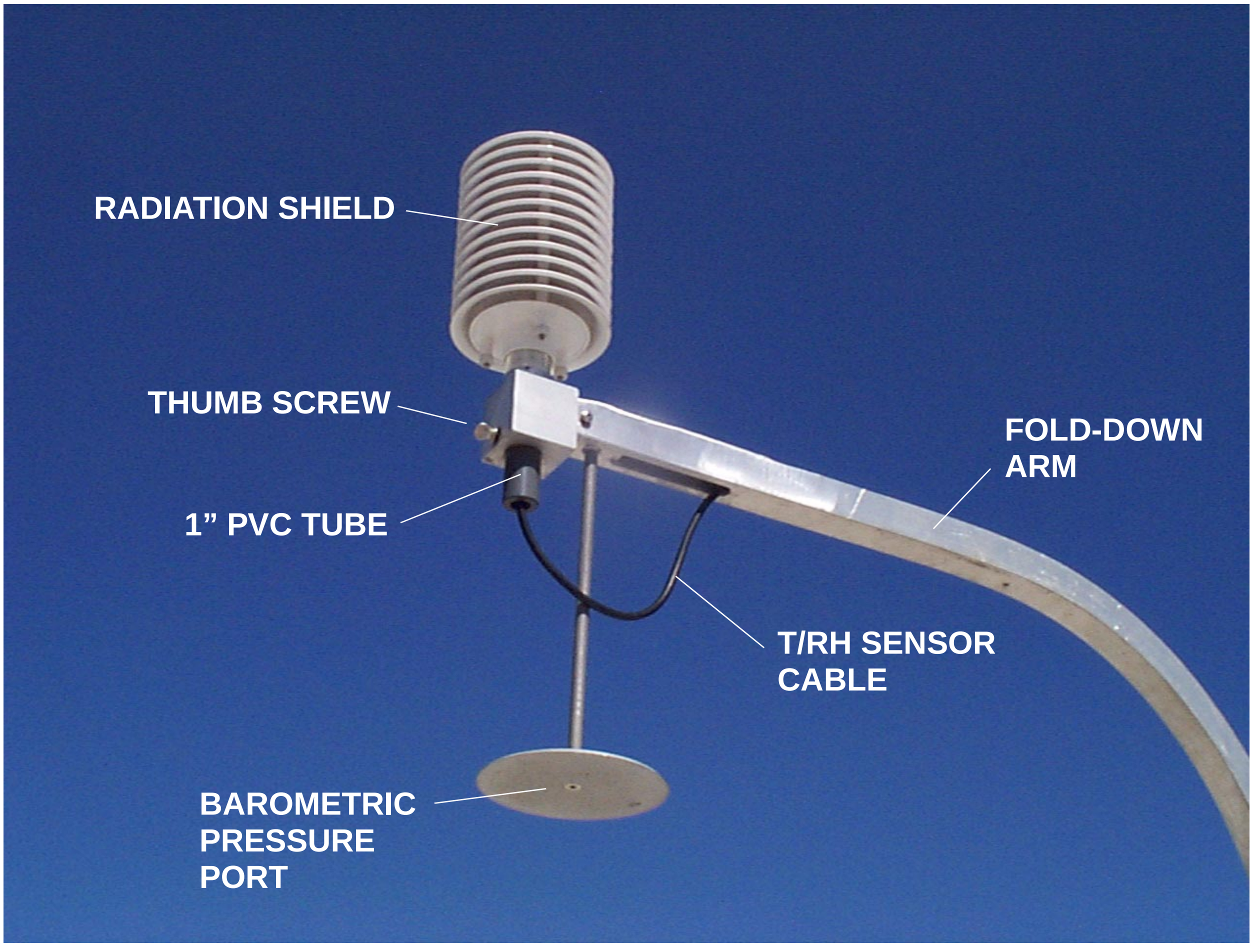

Figure 10-18 GSOS Fold-Down Arm Assembly

10.2.1.3 Power Supply and Communications Interface Assembly

The Power Supply and Communications Interface (PSCI) Assembly consists of a +24 VDC Power Supply Module, an RS422 to RS232 Converter, and a 4-wire communications line surge suppressor (see Figure 10-19). The power and communications interface cable’s quick-disconnect connector provides a convenient method to power cycle the payload from inside the shelter, and simplifies replacement of the PSCI assembly. A wiring schematic for the PSCI is shown in Figure 10-20.

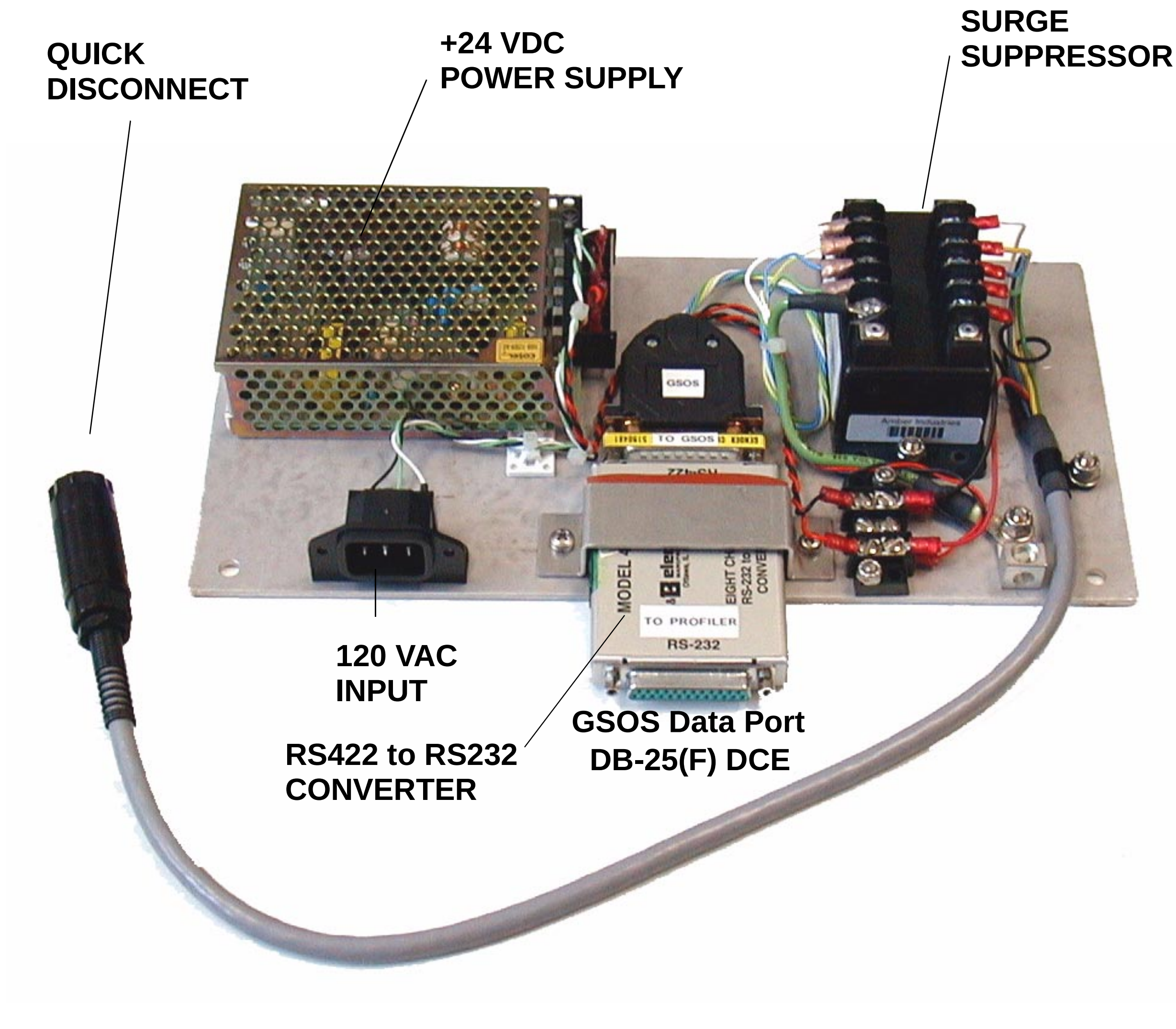

Figure 10-19 GSOS Power Supply and Communications Interface Assembly

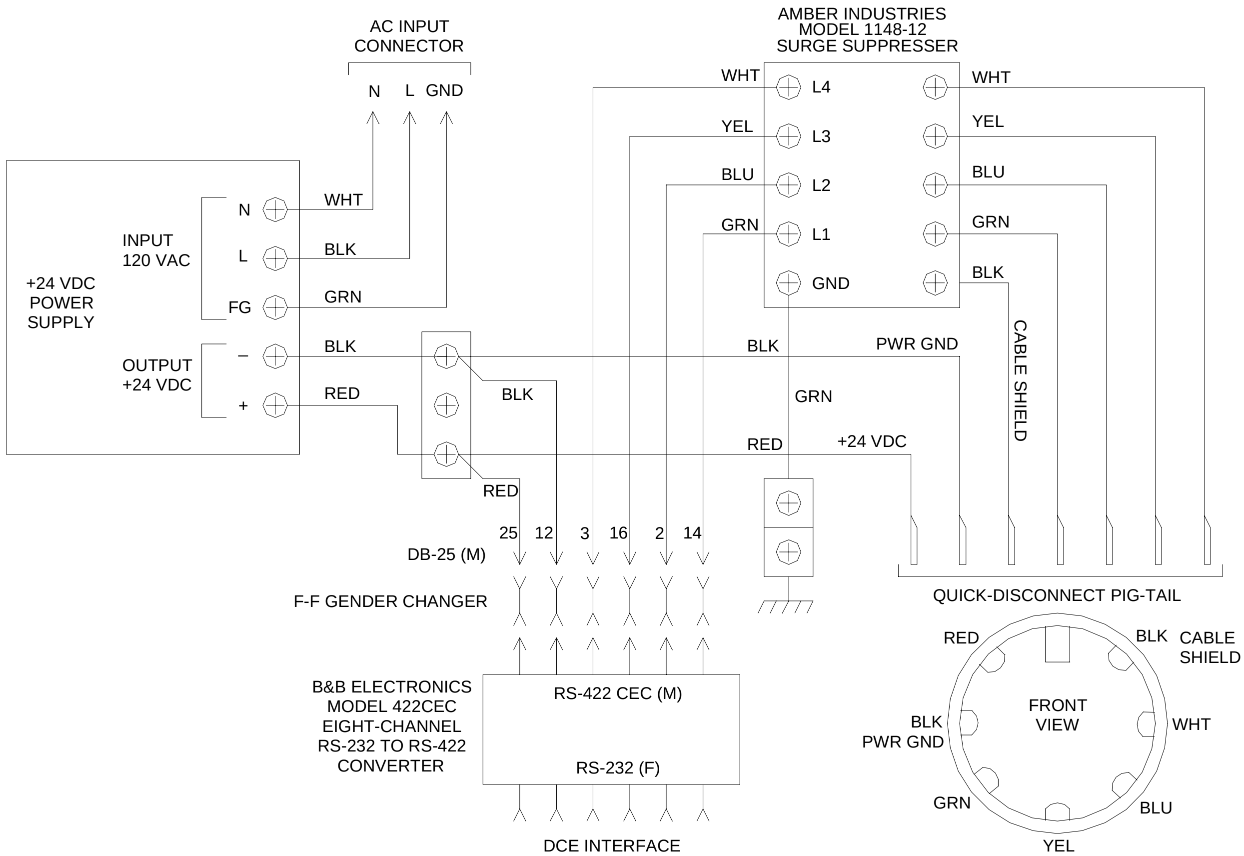

Figure 10-20 GSOS Power & Communications Interface Schematic Diagram

10.2.2 Operations

When power is first applied to the GSOS payload, the controller begins its boot-sequence. During this time, the *L1* and *L2* LED indicators on the contoller's front panel blink, alternating between *L1* and *L2* (about 1-2 times per second). This rapid blink cycle continues until the controller's internal real-time clock reaches a 5-minute boundary (hh:05, hh:10, hh:15 ..... hh:00). Once a 5-minute boundary is reached, the controller enters its normal 5-minute data logging cycle. While the controller is logging data, the *L1* or *L2* LED indicator on the contoller front panel illuminate alternating at each 5-minute boundary. If the controller does not exhibit this behavior, it is most likely damaged.

The controller takes several reading during the 5-minute sample period and calculates the average at the end of the cycle. The averaged reading are stored in a circular-buffer in memory. The buffer can store about 7-days of data before the buffer fills and begins over-writing the oldest data. Power-cycling (or power outage) the GSOS controller will cause all data stored in the circular-buffer to be lost.

GSOS barometer measures *station* pressure and controller calculates *sea-level* pressure. The algorithm requires current *station* barometric pressure and air temperature readings and an air temperature reading from 12 hours earlier to derive a *sea-level* pressure reading. Once power is applied to the GSOS payload (or if the GSOS is power-cycled or loses power) it takes 12 hours of continuous operation before *sea-level* pressure readings will be available.

GSOS is a polled-system, meaning it does not transmit any data unless it receives a request from a host computer. The GSOS controller responds to ACSII character commands. The commands are used to configure site specific parameters and request data. The command syntax covered in the Section 10.2.2.3.

GSOS has two communications ports P1 (GSOS Setup Port) and P3 (GSOS Data Port). Both ports provide similar functionality, with the following exceptions:

- P1 is configured for RS-232 communications.
- P2 is configured for RS485/RS422 communications.
- A computer terminal connected to port P1 allows a user to change the serial port settings for port P3. P3 does not respond to the *PORT* command
- P1 does not respond to data request commands such as *L*, *G*, *CURRENT*, *AVG*, *HOUR*, or *DAY*.

10.2.2.1 GSOS Setup Port

The GSOS Setup Port (P1 on the controller front panel, see Figure 10-12) is an RS232 port primarily used to configure the GSOS with site specific parameters using the command syntax described in the Section 10.2.2.3. A special interface cable is required to use this port, the cable's wiring diagram is shown in Figure 10-21. The serial communications parameter setting for port P1 are fixed at the following values:

Baud Rate:	9600
Data Bits:	8
Stop Bits:	1
Parity:	No
Flow Control:	None

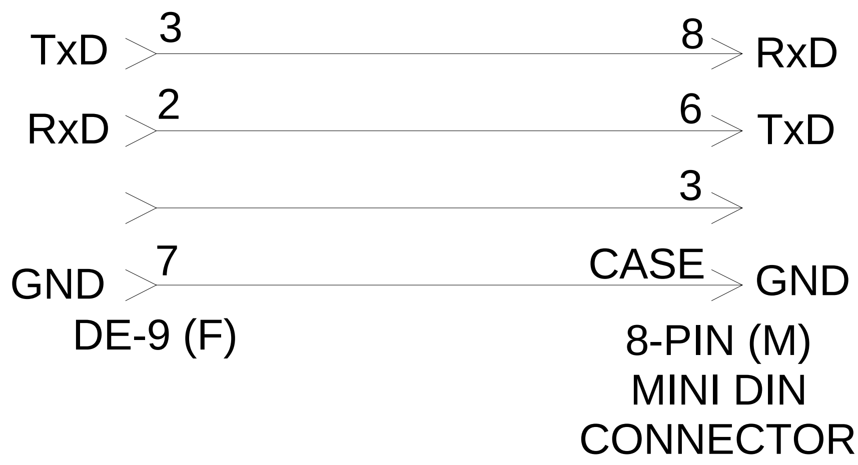

Figure 10-21 GSOS Setup Port (P1) Interface Cable Specifications

10.2.2.2 GSOS Data Port

The GSOS Data Port (P3 on the controller front panel) is an RS-485/RS422 port that interfaces with the host computer through the Power Supply & Communications Interface Assembly (see Figure 10-19). At NOAA Profiler sites, the host computer is the Data Processor Assembly. The Data Processor has an RS-232 port (C1) that is used to interface with auxiliary devices such as GSOS. The cable required to connect the GSOS Power & Communications Interface to the Data Processor (Port C1) is a straight-through DB25P (Male) to DB25S (Female) about 6-FT in length.

The Data Processor polls the GSOS every 6 minutes during the vertical low mode by sending the GSOS an ASCII “L” character. When GSOS receives a poll-character, it transmits a 64-byte string containing the latest 5-minute data samples.

Configuring the Data Processor to interface with GSOS

Several of the Data Processor’s setup parameters must be configured to accept GSOS data. The Profiler Maintenance Terminal (PMT) provides the means to modify these parameters.

1. Connect the PMT interface cable to the DB25 connector on the front panel of the Status Monitor. Start the PMT program on the notebook computer and login to the wind profiler system.

2. Using the Profiler Maintenance Terminal (PMT), place the profiler into *Maintenance Mode*.

3. Select *System Parameters* for the PMT *Main Menu* options.

4. Select *Communications* from the *System Parameters Menu*. The following screen is displayed on the PMT (see Figure 10-22). Use the arrow keys to move cursor to the desired field. Press the *F5* key to select the field. Modify the field as required, and commit the change to the field by pressing the *F6* key.

```
3 WPS-234, PASSWORD REQUIRED                      Maintenance
4 This could take 6 minutes
5 COMMAND EXECUTED
                   Communications Parameters Menu

 Communication Method          BOTH            Landline, Goes, Both

 Goes Id                       750126DA        00000000-FFFFFFFE Hex
 Channel Number                 93             001-199 Decimal
 Transmission Minute            7              00..59
 Transmit Frequency            1               1..6
 Preamble Length               S               S[hort] or L[ong]
 Vertical Parity               Y               Yes or No

 Landline Parameters
 Landline Baud Rate            1200            0300,1200,2400,4800,9600
 x/ON x/OFF Enable             N               Yes or No
 Radiometer Data Inc.          Y               Yes or No
 Radiometer Data Block Length  064             002 to 512 - Even number

 Radiometer Baud Rate          1200            0300,1200,2400,4800,9600



1 Prev  2       3       4       5 select 6Enter  7     8     9      0
```

Figure 10-22 PMT Communications Parameters Menu

5. Set ***Radiometer Data Inc***. to *Y*. This informs to Data Processor that a GSOS unit is connected to port C1, and to poll the GSOS every 6-minutes.

6. Set ***Radiometer Data Block Length*** = *064*. This tells the Data Processor how many bytes of data to expect to be received from the GSOS.

7. Set ***Radiometer Baud Rate*** = *1200*. The baud rate must match the GSOS Data Port baud rate.

8. Return the profiler to *Operational* Mode.

Verifying the Data Processor is receiving data from GSOS

If the Data Processor parameters are configured to expect Radiometer Data (GSOS), the Data Processor will transmit as ASCII "L" character to the GSOS during the vertical low mode of the radar's 6-minute cycle. If the GSOS fails to send a response back to the Data Processor, an *AUXILIARY DEVICE* fault is generated and placed in the radar's Failure Data Log (the Failure Data Log is viewed using the PMT).

The data received from GSOS can be viewed using the PMT Radiometer Data Display. Select *Display Current Output* from the PMT *Main Menu*, select *Landline*, then *Radiometer Data*. A display similar to Figure 10-23 will appear on the PMT screen. The 64-byte ASCII string received from the GSOS is displayed as 1-byte hexadecimal values, refer to Table 10-1 for a Hexadecimal to ASCII Conversion Chart. If all 64 bytes are "00" then no data was received from the GSOS.

```
3 WPS-234, PASSWORD REQUIRED                     Operational
4 This could take 6 minutes
5 COMMAND EXECUTED
                           Radiometer Data

 Mode: 03  Submode: 01         Length 0192      Checksum: 5A6E

                            Radiometer Data

    001..010   01 02 03 04 05 06 07 08 09 0A
    011..020   0B 0C 00 01 02 03 04 05 06 07
    021..030   08 09 0A 0B 0C 00 01 02 03 04
    031..040   05 06 OA 0A 0A 0B 0C 0D 0E 0F
    041..050   05 06 OA 0A 0A 0B 0C 0D 0E 0F
    051..060   05 06 OA 0A 0A 0B 0C 0D 0E 0F
    061..064   05 06 OA 0A







                                                          Prev    Next
1 Prev  2       3       4       5        6       7     8    9Screen 0Screen
```

Figure 10-23 PMT - Landline Output - Radiometer Data

10.2.2.3 GSOS Command Syntax

GSOS commands are one-or-more ASCII characters, terminated by a carriage return <CR>. The commands are not case sensitive, any upper case characters received by the GSOS are converted to lower case. The GSOS commands are divided into two groups, configuration commands and data query commands.

GSOS Command Prompt

The GSOS command prompt is a greater-than character (>). If a terminal is used to interface with GSOS controller, press carriage return <CR> several times until the command prompt ">" is displayed on the terminal screen.

Query Commands

?<CR> or STATUS<CR>

The status commands (? or status) display the current GSOS status, configuration parameters, and help display. Both the Setup Port (P1) and Data Port (P3) respond to the *STATUS* command. However, the responses to the *STATUS* command are slightly different depending on which port is used.

Figure 10-24 is an example response to a *STATUS* command when a terminal is connected to the GSOS Setup Port (P1). Note the command help menu does not include options to query data, this is because the Setup Port does not respond to query commands. The last six 5-minute averaged readings are automatically appended at the end of the *STATUS* message response. If the GSOS controller is reset or power-cycled within 30-minutes of the status command, the number of data sample messages displayed are reduced accordingly.

Figure 10-25 is an example response to a *STATUS* command when a terminal is connected to the GSOS Data Port (P3) through the GSOS Power and Communications Interface. Note the menu provides limited configuration commands. Although the *STATION* and *COEFF* are not listed as available commands, the GSOS will respond to these *hidden* commands if they are received through the Data Port.

```
>?
Status of GSOS system.          V 2.1d
Station ID                    = SITE
Temp/Humidity Sensor          = OK
Pressure Sensor               = OK
Number Measurements in Buffer = 3
Serial Port settings          = 1200, No Parity, 8 Data, 1 Stop
Current Date and Time         =  5 16 2000 22 10 17
Sea Level Coeff. A = 1.0000E+0 B = 1.0000E+0 C = 1.0000E+0 D = 1.0000E+0

   time     = Allows the user to reset the date/time.
   reset    = Will cause the GSOS computer to do a hardware reset.
                  (Use with caution, will lose stored data.)
   status,? = This command.
   port     = Used to setup data port.
   station  = Used to set the Station ID.
   coeff    = Setup Sea Level Pressure Conversion Coefficients.
 Current Data
test 2000 137 21:40  820.72mb  21.75C  46.27%    0.00mb/SL
test 2000 137 21:45  820.58mb  21.76C  46.04%    0.00mb/SL
test 2000 137 21:50  820.40mb  21.75C  46.12%    0.00mb/SL
>
```

Figure 10-24 GSOS Setup Port (P1) Status Display and Help Menu

```
Status of GSOS system.          V 2.1d
Station ID                    = PATB

Temp/Humidity Sensor          = OK
Pressure Sensor               = OK
Number Measurements in Buffer = 0
Serial Port settings          = 1200, No Parity, 8 Data, 1 Stop
Current Date and Time         =  5  3 2000 23  6  1

Sea Level Press Coefficients A = 3.3863E-1  B = 1.0000E+0
                             C = 1.7632E-38  D = 1.7632E-38

   l,current,g = Displays the last 5 minute average stored.
   day[1,2,3,4,5,6] = Displays data for each day, 'day' most current data.
   avg      = Displays the last 30 minutes of data stored.
   hour     = Displays the last hour & 30 minutes of data stored.
   clock    = Displays the current clock date/time setting.
   time     = Allows the user to reset the date/time.
   time MM/DD/YYYY HH:MM:SS = Allows resetting date/time.(No prompting)
   reset    = Will cause the GSOS computer to do a hardware reset.
                  (Use with caution, will lose stored data.)
   status,? = This command.
>
```

Figure 10-25 GSOS Data Port (P3) Status Display and Help Menu

L or G

These commands simulate the request generated every 6-minutes (in vertical low mode) by a wind profiler system. The L is for Landline (latest 6-minute), and G is for GOES (latest hourly average). The GSOS responds with a 64-byte message conforming to the following format:

```
>lEKY1 2000  18  0: 0  914.00mb  31.00C  76.20% 1002.00mb/SL<cr><lf><cr><lf><lf>
 lssss yyyy jjj hh:mm pppp.pp   ±tt.tt  hhh.hh  PPPP.PP
 1234567890123456789012345678901234567890123456789
          1         2         3         4         5          60  61  62  63  64

where: L,l,G,g = poll command character echoed by the GSOS when received.
          ssss = site name or ID.
          yyyy = Year Timestamp (based on GSOS controller Real-Time Clock).
           jjj = Julian Date Timestamp (based on GSOS controller Real-Time Clock).
            hh = Hour Timestamp (based on GSOS controller Real-Time Clock).
            mm = Minute Timestamp (based on GSOS controller Real-Time Clock).
       pppp.pp = station barometric pressure in millibar.
        ±tt.tt = Air Temperature in degrees Celsius.
        hhh.hh = Relative Humidity from 0 - 100%
       PPPP.PP = Sea-Level (derived) Barometric Pressure in millibar.
          <cr> = ASCII Carriage Return character.
          <lf> = ASCII Line-Feed character.
```

CURRENT<CR>

Same as L or G, except the poll character (L,l,G,or g) are not echoed in the response.

AVG<CR>

The *AVG* command causes GSOS to transmit the six most-recent 5-minute data samples as shown in the example below:

```
>avg<CR>
WLCI 2000 123 18:10  995.36mb  19.68C  53.98% 1020.78mb/SL
WLCI 2000 123 18:15  995.42mb  19.86C  52.74% 1020.84mb/SL
WLCI 2000 123 18:20  995.40mb  19.83C  51.79% 1020.82mb/SL
WLCI 2000 123 18:25  995.36mb  20.07C  50.37% 1020.78mb/SL
WLCI 2000 123 18:30  995.45mb  20.27C  50.87% 1020.86mb/SL
WLCI 2000 123 18:35  995.48mb  20.27C  48.84% 1020.90mb/SL
```

HOUR<CR>

The *HOUR* command causes GSOS to transmit the last several hours of 5-minute data samples as shown in the example below:

```
>hour<CR>
WLCI 2000 123 17:10  995.43mb  18.82C  60.07% 1020.85mb/SL
WLCI 2000 123 17:15  995.46mb  18.84C  55.69% 1020.88mb/SL
WLCI 2000 123 17:20  995.48mb  19.19C  57.64% 1020.90mb/SL
WLCI 2000 123 17:30  995.45mb  19.11C  55.46% 1020.87mb/SL
  .
  .
  .
WLCI 2000 123 18: 5  995.32mb  19.87C  55.57% 1020.73mb/SL
WLCI 2000 123 18:10  995.36mb  19.68C  53.98% 1020.78mb/SL
WLCI 2000 123 18:15  995.42mb  19.86C  52.74% 1020.84mb/SL
WLCI 2000 123 18:20  995.40mb  19.83C  51.79% 1020.82mb/SL
WLCI 2000 123 18:25  995.36mb  20.07C  50.37% 1020.78mb/SL
WLCI 2000 123 18:30  995.45mb  20.27C  50.87% 1020.86mb/SL
WLCI 2000 123 18:35  995.48mb  20.27C  48.84% 1020.90mb/SL
```

Configuration Commands

STATION<CR>

Changes the name of the Station ID stored in the GSOS. The following prompt is displayed:

```
Enter Station ID (4 char)
>
```

COEFF<CR>

Changes of values of four coefficients (A,B,C,and D) stored in the GSOS used to calculate Sea-Level Pressure. Coefficient values are different for every site location. GSOS prompts individually for each of the coefficient values as show below:

```
Coefficient A
>0.0000234
Coefficient B
>0.0000045
Coefficient C
>1
Coefficient D
>0
>
```

Number less than zero should be entered with a leading zero (0.0...). Numbers equal to 1 or 0 should be entered as integer values.

TIME<CR>

Used to interactively set the GSOS internal Real-Time Clock. A continuously updating time is shown, the user can then choose to update the clock by selecting Y (yes) or keep the existing time by selecting N (no). If Yes is selected, the following prompt is displayed:

```
Please Initialize Time

MM DD YYYY HH MM SS
_
```

Enter values with leading zeros (if less than 10) and separate with spaces. Press Enter <CR> to commit values.

TIME mm/dd/yyy hh:mm:ss<CR>

Used to non-interactively set the GSOS internal Real-Time Clock. After the new date/ time values have been entered, by GSOS displays the following message.

```
Sampling Time Reset
Please Wait
......................
>
```

The GSOS prints a succession of dots, until the internal clock reaches the next 5-minute boundary, at which point the command prompt (>) is displayed. You must wait until the command prompt is displayed before attempting to enter any commands.

PORT<CR>

Changes the serial communications parameters for port P3 (GSOS Data Port). The *PORT* command can only be executed when connected to the Setup Port (P1). The following prompts are displayed: (Select values by entering the number on left)

```
Set Output Port Baud Rate
1 = 1200
2 = 2400
3 = 4800
4 = 9600
5 = 19200
>
```

```
  Set Output Port Stop Bits
  1 = 1 Stop Bit
  2 = 2 Stop Bit

  >

  Set Output Port Data Bits
  1 = 7
  2 = 8

  >

  Set Output Port Parity
  1 = No Parity
  2 = Even Parity
  3 = Odd Parity

  >

Use the RESET command to make communication setting take affect.

>
```

RESET<CR>

The RESET command resets the controller's CPU, having the same effect as power-cycling the GSOS. All stored measurements stored in memory are lost. During the boot-up process the following message is displayed:

```
  Power UP.
  ...................................
  GSOS Version 2.1d

  >
```

GSOS prints a succession of dots until its internal clock reaches a 5-minute boundary. GSOS then enters its normal 5-minute data logging cycle and prints the controller's firmware version and command prompt (>) on the screen.

10.2.3 Replacement Procedures

The following tools are required to and replace GSOS components:

- #2 Phillips Head Screwdriver
- #2 Flat Blade Screwdriver
- Small Flat Blade Screwdriver
- 1/16” Allen Head Wrench
- 3/4” Adjustable Wrench (Crescent Wrench) or
- 3/4”, 5/8”, 9/16”,1/2”, and 5/16” Open-end Wrenches
- Diagonal Cutters/Utility Knife

10.2.3.1 Payload Replacement

1. Disconnect the Power & Communications Interface Cable from the bottom of the GSOS Payload enclosure (see Figure 10-26).

2. Unscrew the four captive fasteners on the enclosure door and open enclosure. The door is hinged on the left side of the enclosure (see Figure 10-26).

3. Disconnect the barometric pressure hose from bulk-head fitting on the bottom of the GSOS Payload enclosure (see Figure 10-26).

4. Disconnect the ground wires from the bottom the GSOS enclosure (see Figure 10-26).

5. Remove the cotter pin from the fold-down arm and lower the arm counter-clockwise (see Figure 10-27).

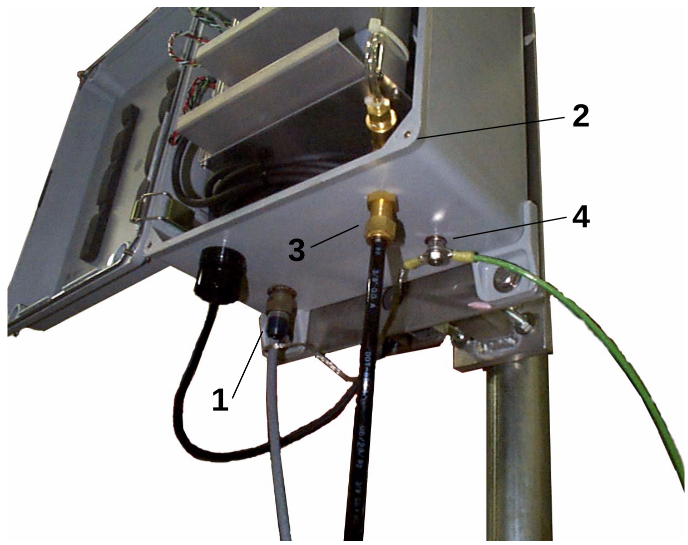

Figure 10-26 Payload Interfaces

Figure 10-27 Lower Fold-Down Arm

6. Loosen the thumb screw at the top of the arm and remove the sensor mounting assembly (1” gray PVC tube) from the arm (see Figure 10-28).

7. Unscrew the allen-head setscrew holding the T/RH Probe inside the PVC tube and remove the probe from the tube.

8. At the base of the fold-down arm, pull the T/RH cable out of the arm, while feeding the probe through the slot at the top on the arm.

9. Unscrew the compression nut from the stuffing tube where the T/RH cable enters the GSOS enclosure (see Figure 10-29).

10. Feed in the T/RH cable into the GSOS enclosure through the stuffing tube and coil the sensor cable inside the enclosure below the card cage.

11. Re-assemble and tighten the T/RH cable stuffing tube.

12. Close and fasten the door in the GSOS enclosure.

13. Remove the four mounting screws fastening the GSOS enclosure to the mounting assembly and remove the enclosure from the mounting assembly.

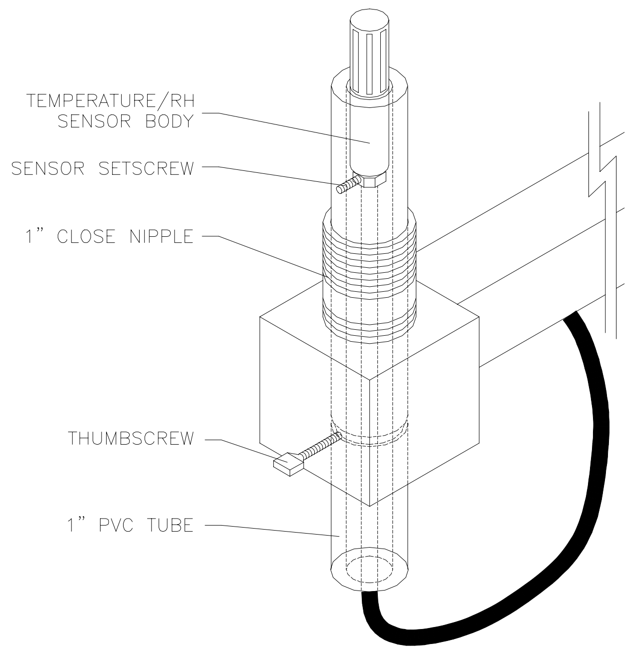

Figure 10-28 T/RH Sensor Removal

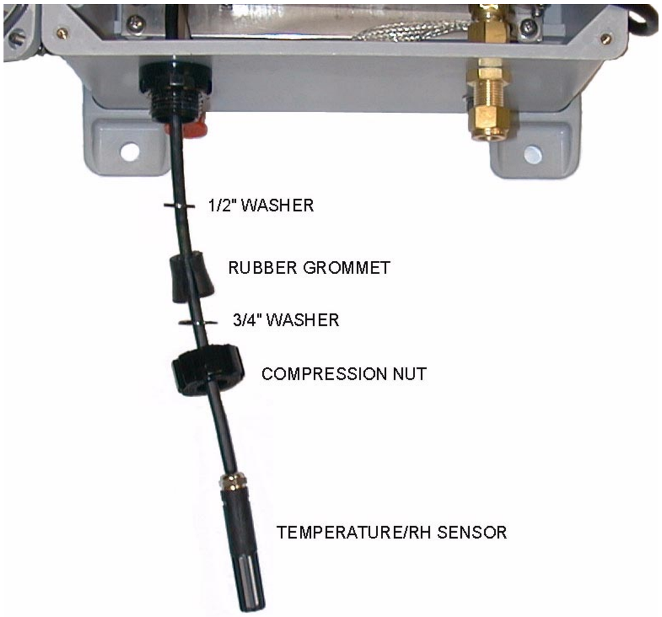

Figure 10-29 Payload Stuffing Tube

14. Mount the replacement GSOS enclosure to the mounting assembly and secure the four fasteners.

15. Open the GSOS enclosure and un-coil the T/RH Cable. Straighten the cable and remove any kinks.

16. Feed the T/RH sensor though the stuffing tube (and its washers and grommet) as shown in Figure 10-29. The T/RH probe body is too large to fit through the stuffing tube washers and grommet. Make diagonal cuts in the washers and grommet with diagonal cutters or a utility knife.

17. Feed the pull-cord (provided with the payload) from the slot at the top of fold-down arm, though the arm towards the base.

18. Remove the yellow protective cover from the T/RH sensor and attach the pull-cord to the T/RH sensor with electrical tape.

19. Feed the T/RH Sensor through the fold-down arm with your right hand, while pulling the pull-cord with your left hand. Pull enough cable through the arm to form an adequate drip-loop in the sensor cable.

20. Position the T/RH probe inside the mounting assembly such that the metallic base of the probe body aligns with the sensor setscrew (a port hole drilled in the PVC tube opposite the setscrew provides the means to visually align the probe in the PVC tube). Tighten the setscrew to secure the sensor.

21. Insert the PVC tube into the aluminum housing until the scribe line on the PVC tube is flush with the aluminum housing. (This ensures the thumb screw will properly seat in the groove milled in the PVC tube.) Tighten the thumb screw to secure the PVC tube in position.

22. Gather the excess T/RH sensor cable and coil it in the bottom of the GSOS enclosure.

23. Rise the Fold-Down arm and install the cotter pin to secure the arm in the vertical position.

24. Adjust the length of the T/RH sensor cable to allow the Fold-Down Arm to be lowered or raised without stressing the T/RH cable. Tighten the stuffing tube compression nut.

25. Connect the barometric pressure hose and ground wires to the GSOS enclosure as shown in Figure 10-26.

26. Connect the Power & Communications cable to the GSOS enclosure interface connector.

27. Refer to “Operations” in Section 10.2.2 to verify proper operation of the GSOS controller.

28. Secure the cover on the GSOS enclosure. **DO NOT OVER-TIGHTEN THE SCREWS OR THE CORNERS OF THE ENCLOSURE DOOR WILL CRACK!**

10.2.3.2 Controller Replacement

1. Disconnect the Power & Communications Interface Cable from the bottom of the GSOS Payload enclosure.

2. Unscrew the four captive fasteners on the enclosure door. The door is hinged on the left side of the enclosure.

3. Unplug the controller’s 15-pin *Molex* connector from the panel to the left of the card cage.

4. Slide the controller assembly from the card cage.

5. Slide the replacement controller into the card cage.

6. Connect the controller’s 15-pin Molex connector to panel to the left of the card cage.

7. Connect the Power & Communications Interface Cable on the bottom of the enclosure.

8. Refer to “Operations” in Section 10.2.2 to verify proper operation of the GSOS controller.

9. Close and enclosure door and fasten the four captive screws. **DO NOT OVER-TIGHTEN THE SCREWS OR THE CORNER OF THE ENCLOSURE DOOR WILL CRACK!**

10.2.3.3 Barometric Pressure Sensor Replacement

1. Disconnect the Power & Communications Interface Cable from the bottom of the GSOS Payload enclosure.

2. Unscrew the four captive fasteners on the enclosure door. The door is hinged on the left side of the enclosure.

3. Unplug the barometer's 6-pin *Molex* connector from the panel to the left of the card cage.

4. Cut the nylon cable tie securing the pressure hose at the barometer input port. Disconnect the hose from the barbed fitting.

5. Slide the barometer assembly from the card cage.

6. Slide the replacement barometer assembly into the card cage.

7. Connect the barometer's 6-pin Molex connector to panel to the left of the card cage.

8. Connect the pressure hose to the barbed fitting the barometer. Secure the hose to the fitting with the supplied cable tie.

9. Connect the Power & Communications Interface Cable on the bottom of the enclosure.

10. Refer to "Operations" in Section 10.2.2 to verify proper operation of the GSOS controller.

11. Close and enclosure door and fasten the four captive screws. **DO NOT OVER-TIGHTEN THE SCREWS OR THE CORNER OF THE ENCLOSURE DOOR WILL CRACK!**

10.2.3.4 Temperature/RH Sensor Replacement

1. Disconnect the Power & Communications Interface Cable from the bottom of the GSOS Payload enclosure.

2. Unscrew the four captive fasteners on the enclosure door. The door is hinged on the left side of the enclosure.

3. Unplug the T/RH sensors's 9-pin *Molex* connector from the panel to the left of the card cage.

4. Remove the cotter pin from the fold-down arm and lower the arm counter-clockwise (see Figure 10-30).

Figure 10-30 Lower Fold-Down Arm

5. Loosen the thumb screw at the top of the arm and remove the sensor mounting assembly (1” gray PVC tube) from the arm (see Figure 10-31).

6. Unscrew the allen-head setscrew holding the T/RH Probe inside the PVC tube and remove the probe from the tube.

7. At the base of the fold-down arm, pull the T/RH cable out of the arm, while feeding the probe through the slot at the top on the arm.

8. Unscrew the compression nut from the stuffing tube where the T/RH cable enters the GSOS enclosure (see Figure 10-32).

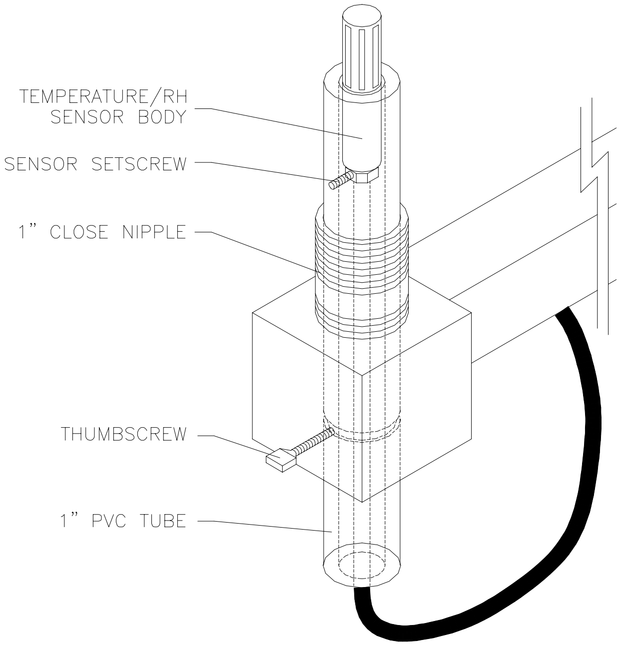

Figure 10-31 T/RH Sensor Removal

9. Feed in the T/RH cable into the GSOS enclosure through the stuffing tube and coil the sensor cable.

10. Slide the T/RH sensor assembly from the card cage.

11. Slide the replacement T/RH sensor assembly into the card cage.

12. Connect the sensor’s 9-pin Molex connector to panel to the left of the card cage.

13. Feed the T/RH sensor though the stuffing tube (and its washers and grommet) as shown in Figure 10-32. The T/RH probe body is too large to fit through the stuffing tube washers and grommet. Make diagonal cuts in the washers and grommet with diagonal cutters or a utility knife.

14. Feed the pull-cord (provided with the payload) from the slot at the top of fold-down arm, though the arm towards the base.

15. Remove the yellow protective cover from the T/RH sensor and attach the pull-cord to the T/RH sensor with electrical tape.

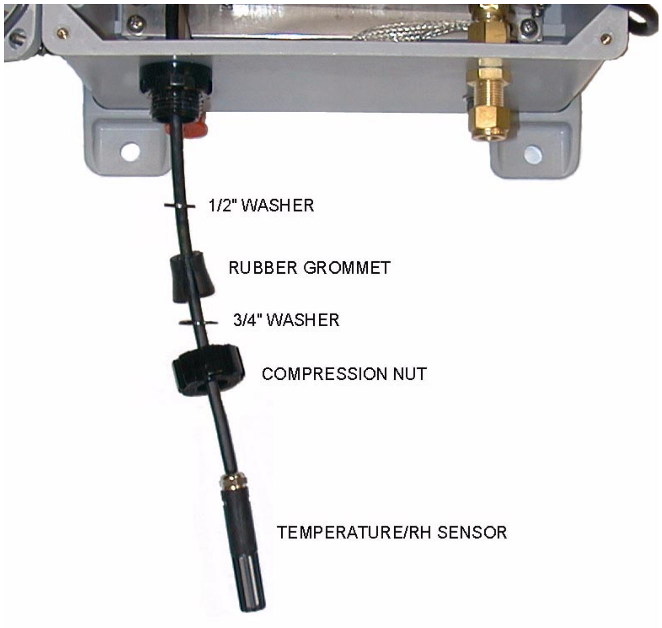

Figure 10-32 Payload Stuffing Tube

16. Feed the T/RH Sensor through the fold-down arm with your right hand, while pulling the pull-cord with your left hand. Pull enough cable through the arm to form an adequate drip-loop in the sensor cable.

17. As shown in Figure 10-31, position the T/RH probe inside the mounting assembly such that the metallic base of the probe body aligns with the sensor setscrew (a port hole drilled in the PVC tube opposite the setscrew provides the means to visually align the probe in the PVC tube). Tighten the setscrew to secure the sensor.

18. Insert the PVC tube into the aluminum housing until the scribe line on the PVC tube is flush with the aluminum housing. (This ensures the thumb screw will properly seat in the groove milled in the PVC tube.) Tighten the thumb screw to secure the PVC tube in position.

19. Gather the excess T/RH sensor cable and coil it in the bottom of the GSOS enclosure.

20. Rise the Fold-Down arm and install the cotter pin to secure the arm in the vertical position.

21. Adjust the length of the T/RH sensor cable to allow the Fold-Down Arm to be lowered or raised without stressing the T/RH cable. Tighten the stuffing tube compression nut.

22. Connect the Power & Communications Interface Cable on the bottom of the enclosure.

23. Refer to “Operations” in Section 10.2.2 to verify proper operation of the GSOS controller and T/RH sensor.

24. Close and enclosure door and fasten the four captive screws. **DO NOT OVER-TIGHTEN THE SCREWS OR THE CORNER OF THE ENCLOSURE DOOR WILL CRACK!**

11 GPS-IPW Observing System

The Global Positioning Satellite (GPS) - Integrated Precipitable Water vapor (IPW) Observing System provides a cost effective method to measure total column water vapor in the atmosphere directly above a fixed site. The method uses GPS dual-frequency receivers and surface meteorological sensors to measure excess GPS signal delays caused by water vapor in the atmosphere. By subtracting the effects of the ionosphere, troposphere, and barometric pressure on signal delays, water vapor measurements can be calculated. Each NOAA Profiler Network (NPN) site is equipped with a GPS-IPW and a surface meteorological observing system. This section provides information required to maintain and repair the GPS-IPW equipment located at each profiler site.

11.1 System Description

11.1.1 Electronics Assembly

The GPS-IPW Electronics Assembly consists of a Trimble Receiver, +15 VDC Power Supply, and a 300 VA Uninterruptible Power Supply (UPS) integrated into a 19” rack-mountable tray (see Figure 11-1). Assemblies are fastened to the rack tray using foam rubber pads and nylon straps as shown in Figure 11-2. The rack assembly is mounted in the profiler shelter Equipment Cabinet above the Data Processor Assembly (see Figure 4-1).

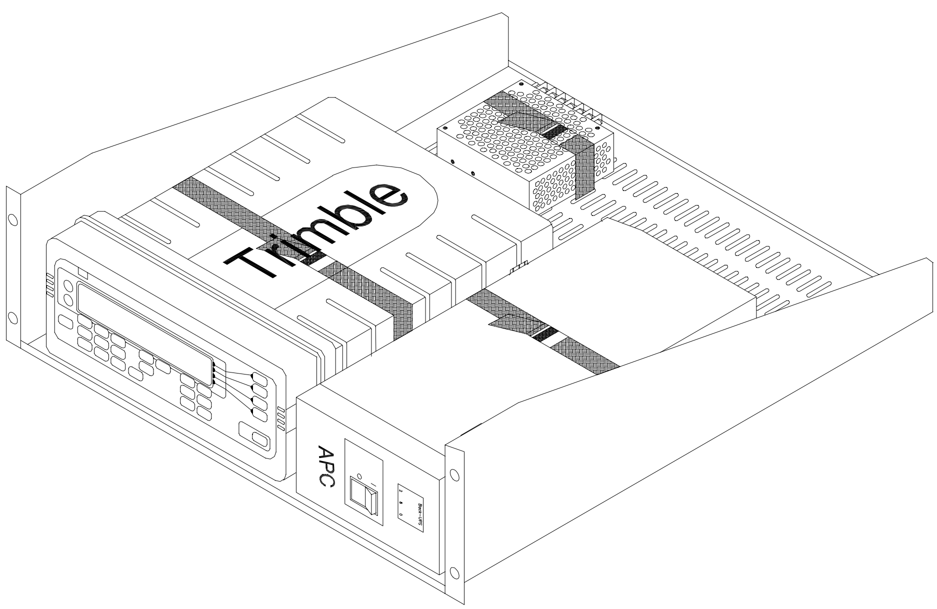

Figure 11-1 GPS Electronics Assembly

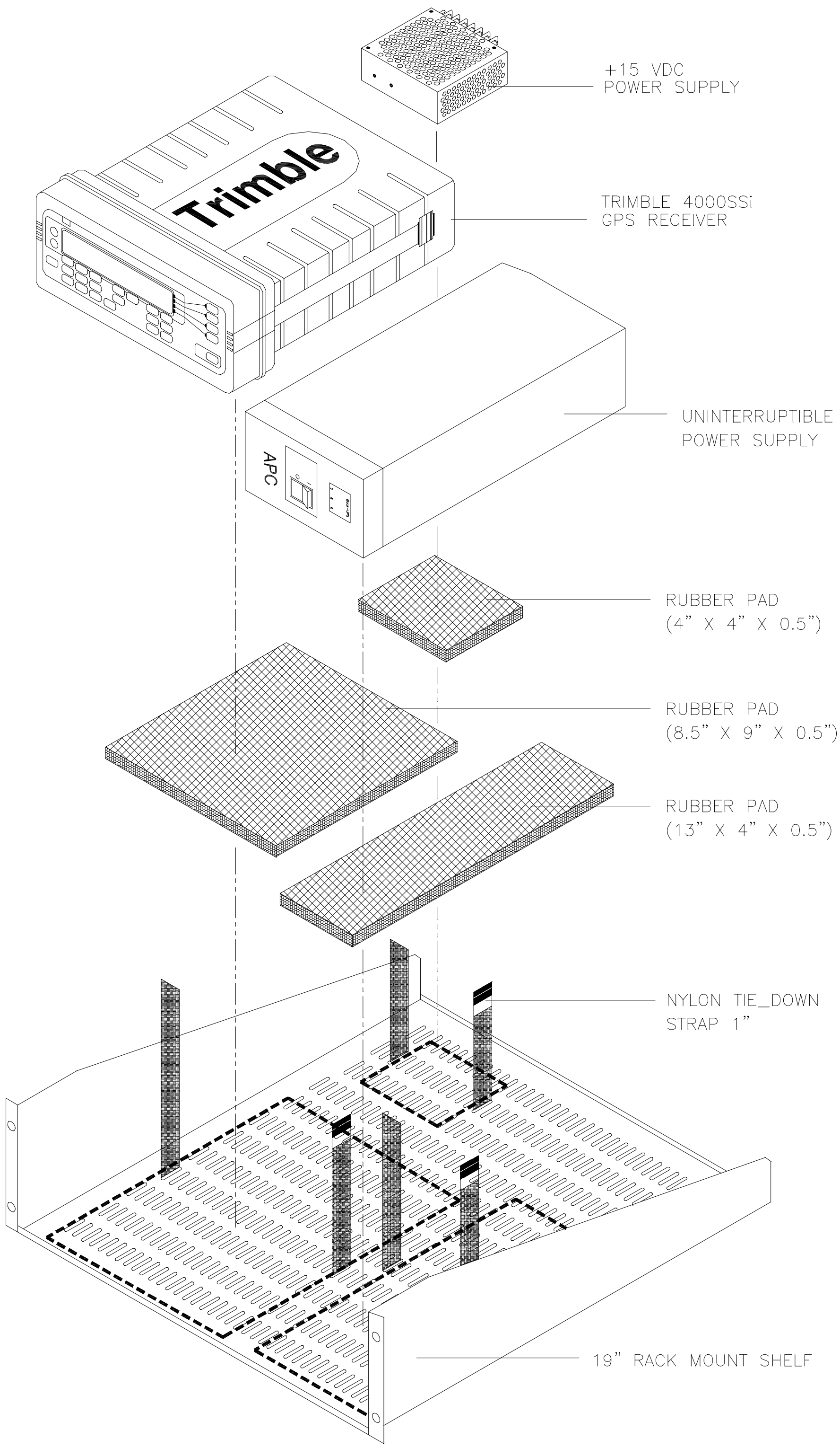

Figure 11-2 GPS Electronics Mechanical Assembly

11.1.1.1 Receiver Assembly

The receiver assembly is a Trimble Model 4000SSi Dual Frequency Receiver (see Figure 11-3). Once survey is enabled, it runs continuously collecting data on a half-hourly cycle. Normally, data are down loaded from the receiver to the GPS Hub in Boulder, CO every half-hour. If communication problems prevent the normal down load cycle from occurring, the receiver is equipped with enough memory to buffer approximately one week of data. However, once the receiver's memory fills up, data collection stops until the files on the receiver are either down loaded or deleted.

The receiver rear panel interface ports ***AUX*** and ***I/O 2*** are 7-pin (Female) *Lemo* connectors, ports ***PWR-I/O 1*** and ***PWR 2&3*** are 5-pin (Female) *Lemo* connectors. The ***ANTENNA*** port is a coaxial (Female) Lemo connector and the ***EXT REF*** port is a BNC (Female) connector.

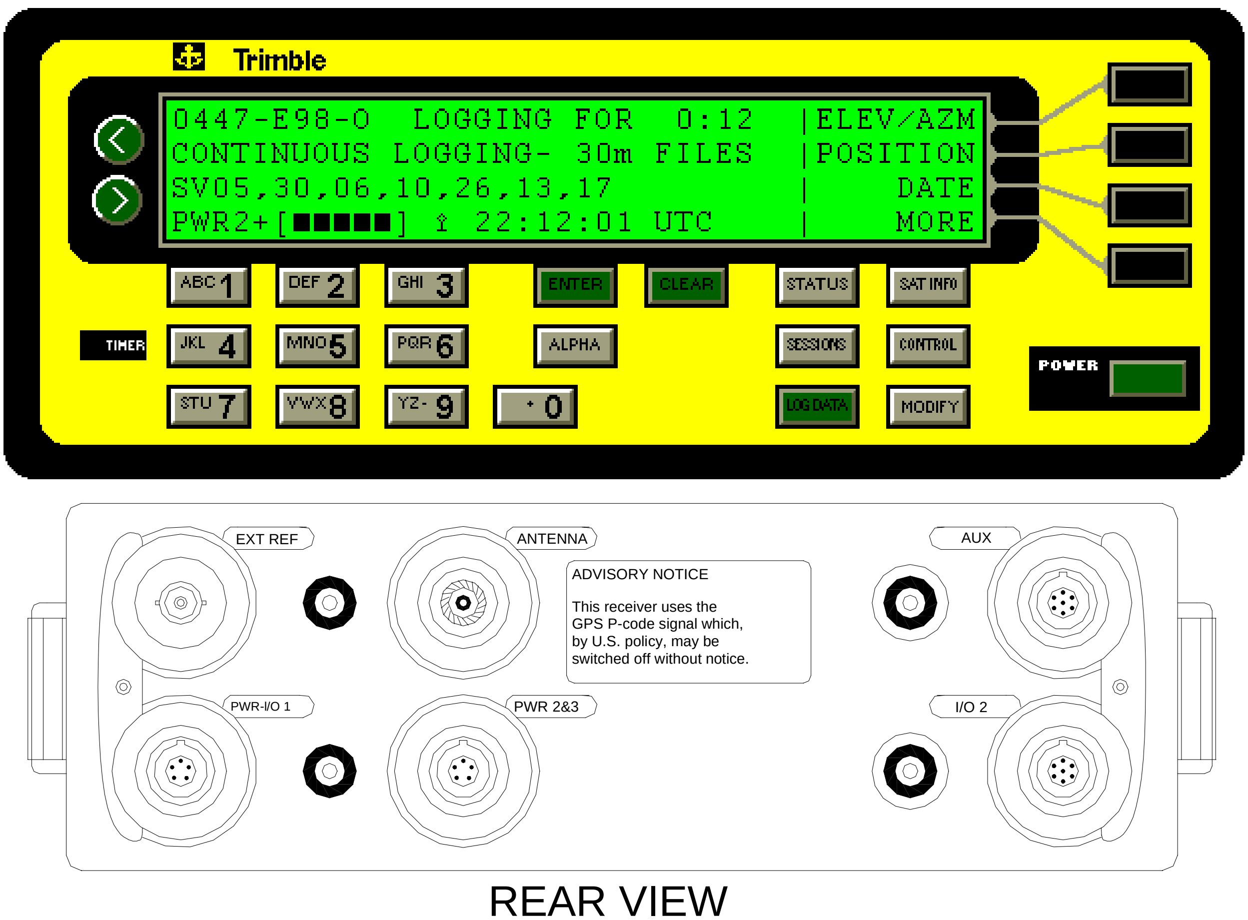

Figure 11-3 Trimble GPS Receiver Front and Rear Panel Views

11.1.1.2 +15 VDC Power Supply Assembly

The +15 VDC Power Supply Assembly provides the GPS receiver's supply voltage (see Figure 11-4). The power supply accepts 120 VAC input and can provide up to 1 Amp of output current at 15 VDC.

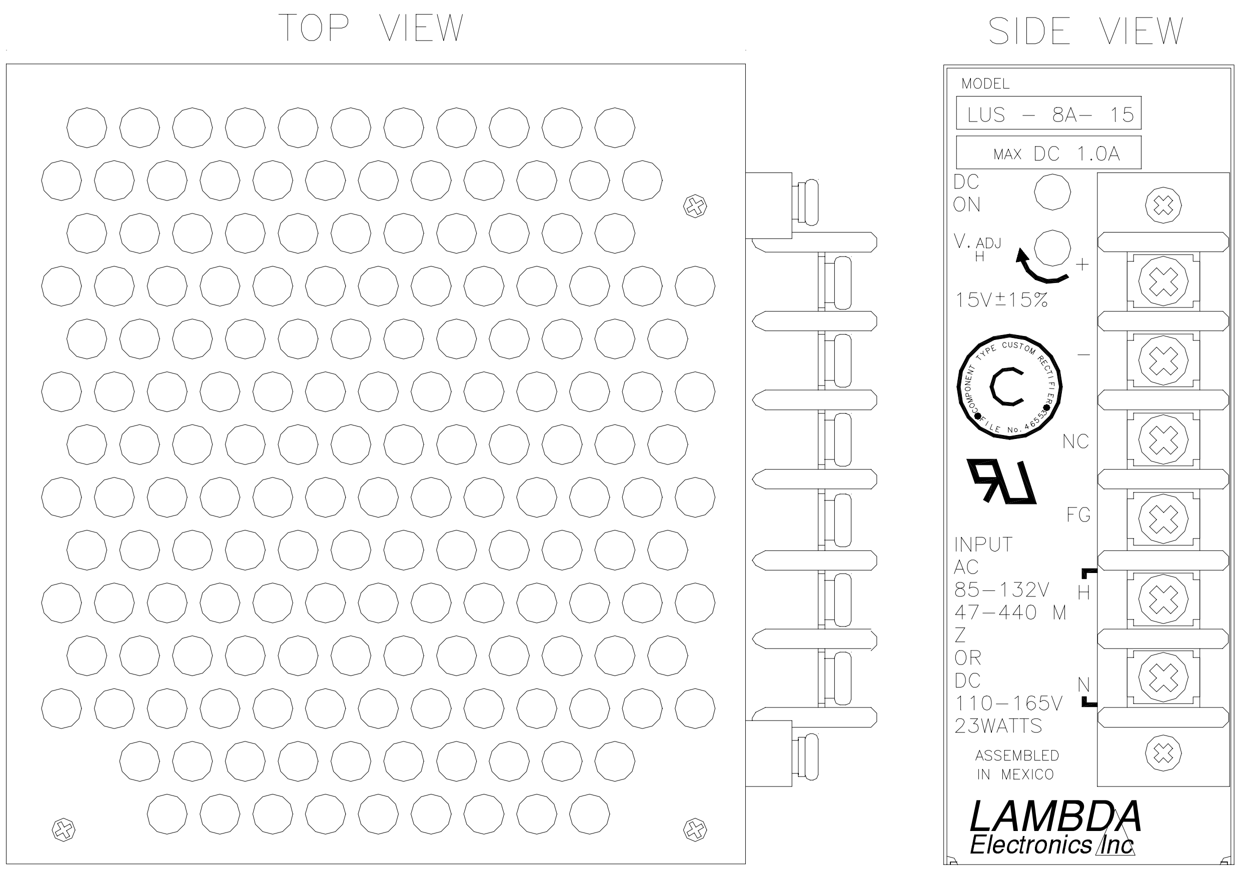

Figure 11-4 15 VDC Power Supply

11.1.1.3 Uninterruptible Power Supply (UPS) Assembly

The UPS supplies AC line voltage for the +15 VDC Power Supply Assembly (see Figure 11-5). The UPS is rated at 300 VA, which is sufficient capacity to run the receiver for several hours during a localized power failure.

Note: Replacement UPS assembly battery terminals are disconnected for shipment. Always inspect the UPS to insure that the battery terminals are connected prior to installing the replacement unit.

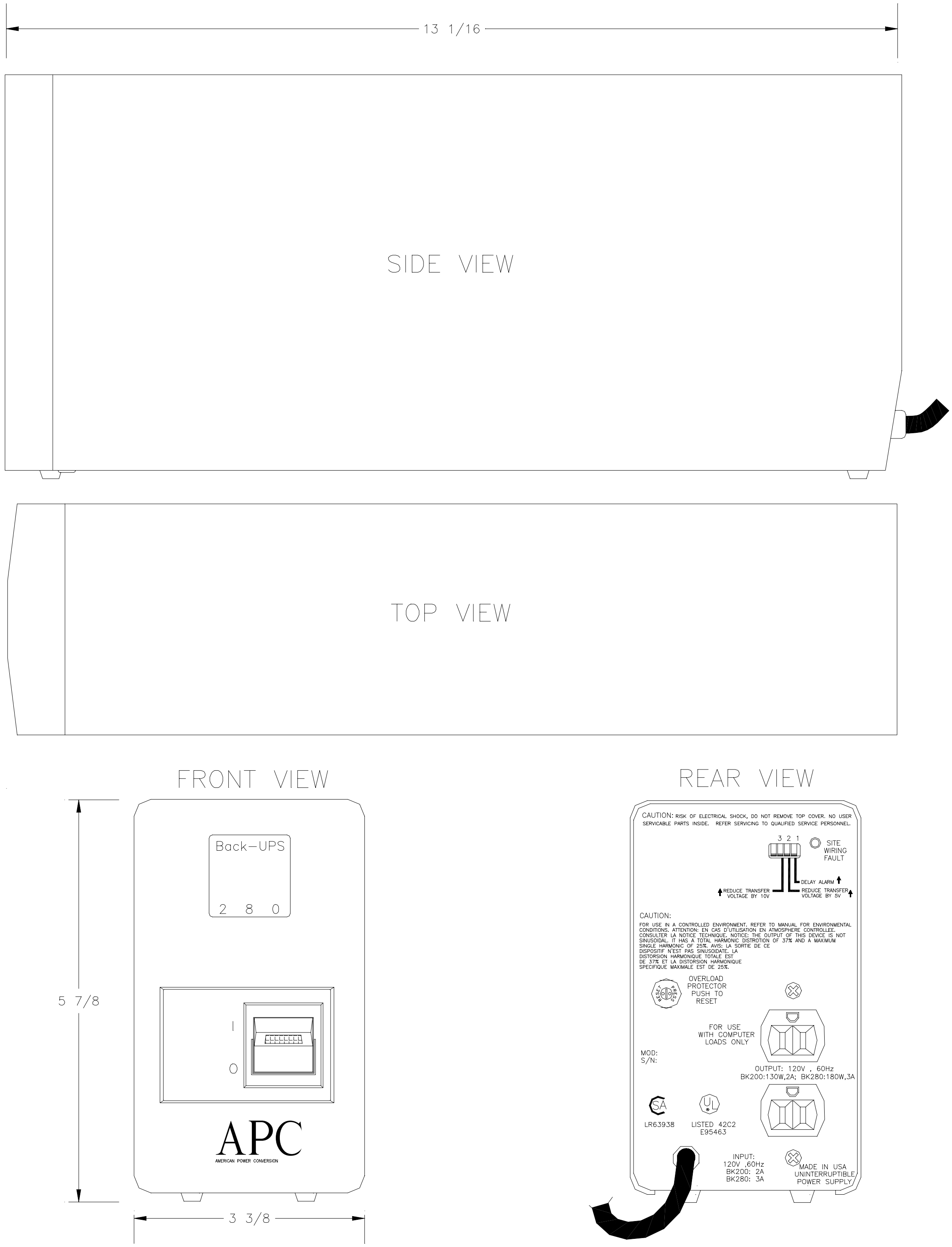

Figure 11-5 UPS Assembly

11.1.2 Antenna Assembly

11.1.2.1 Dual Frequency Antenna Assembly

Trimble's dual frequency Micro-centered™ L1/L2 Antenna provides high-precision results using Trimble’s patented technology (see Figure 11-6). The Micro-centered Antenna provides phase-center stability similar to Choke Ring Antennas and improves positions by up to 5 mm. The ground plane enhances phase center stability in high-multipath environments. The antenna’s interface port is a standard type N (Female) connector.

Figure 11-6 Micro-Centered Antenna

11.1.2.2 Antenna Mount Assembly

The Antenna Mount Assembly is designed to allow a GPS antenna to be mounting on the one of the corner fence posts surrounding the profiler antenna compound (see Figure 11-7). The base fits over a 3” post and is fastened using six set-screws. The upper portion of the assembly provides mounting and leveling adjustments for the GPS antenna.

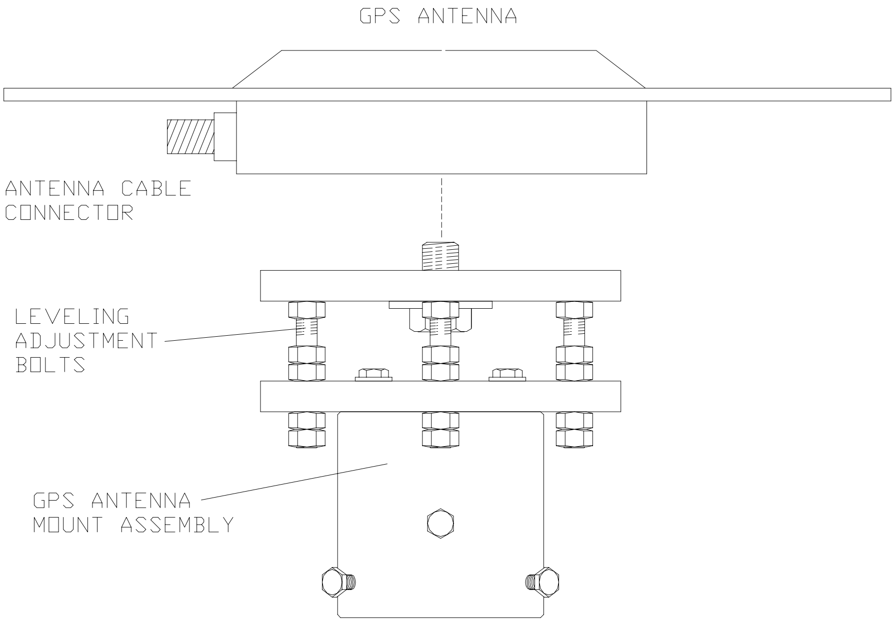

Figure 11-7 GPS Antenna Mount Assembly

11.1.2.3 Antenna Radome Assembly

The GPS antenna radome is a plastic cone that fits over the antenna assembly to help prevent snow and ice from accumulating on the antenna ground plane surface (see Figure 11-8). The radomes are primarily used at northern locations where snow-fall is most prevalent.

The radome attaches to the antenna ground plane using special brackets made of phenolic plastic (see Figure 11-9). Six brackets clamp onto the antenna ground plane using 2 nylon set-screws. The radome attaches to the adaptors using six nylon screws.

Figure 11-8 Antenna Radome

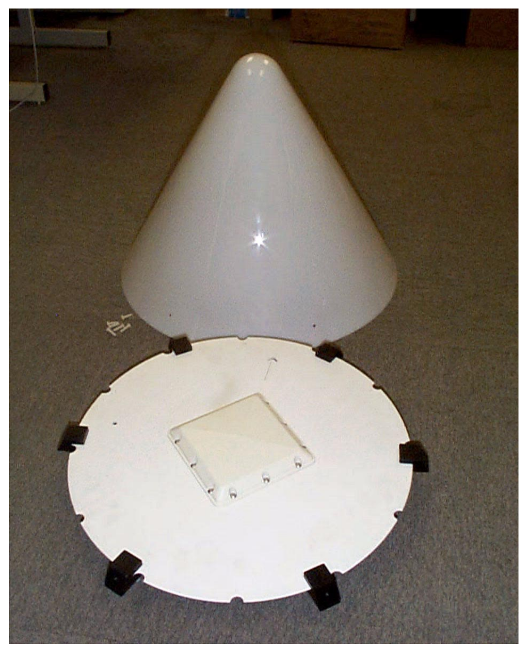

Figure 11-9 Radome Fasteners

11.1.3 System Cabling and Communication Interfaces

Figure 11-10 is the cabling interconnection diagram for the GPS-IPW Observing System. Figure 11-11 provides specification for the GPS receiver power cable. Figure 11-12 provides the specification for the Data Communications Equipment (DCE) cable that connected to port ***PWR I/O 1*** on the GPS receiver rear panel. The DCE cable provides local RS-232 interface with the receiver. Figure 11-13 provides the specifications for the Data Terminal Equipment (DTE) cable that connects to port ***I/O 2*** on the GPS receiver rear panel. The DTE cable provides an RS-232 Null-Modem interface for communications equipment.

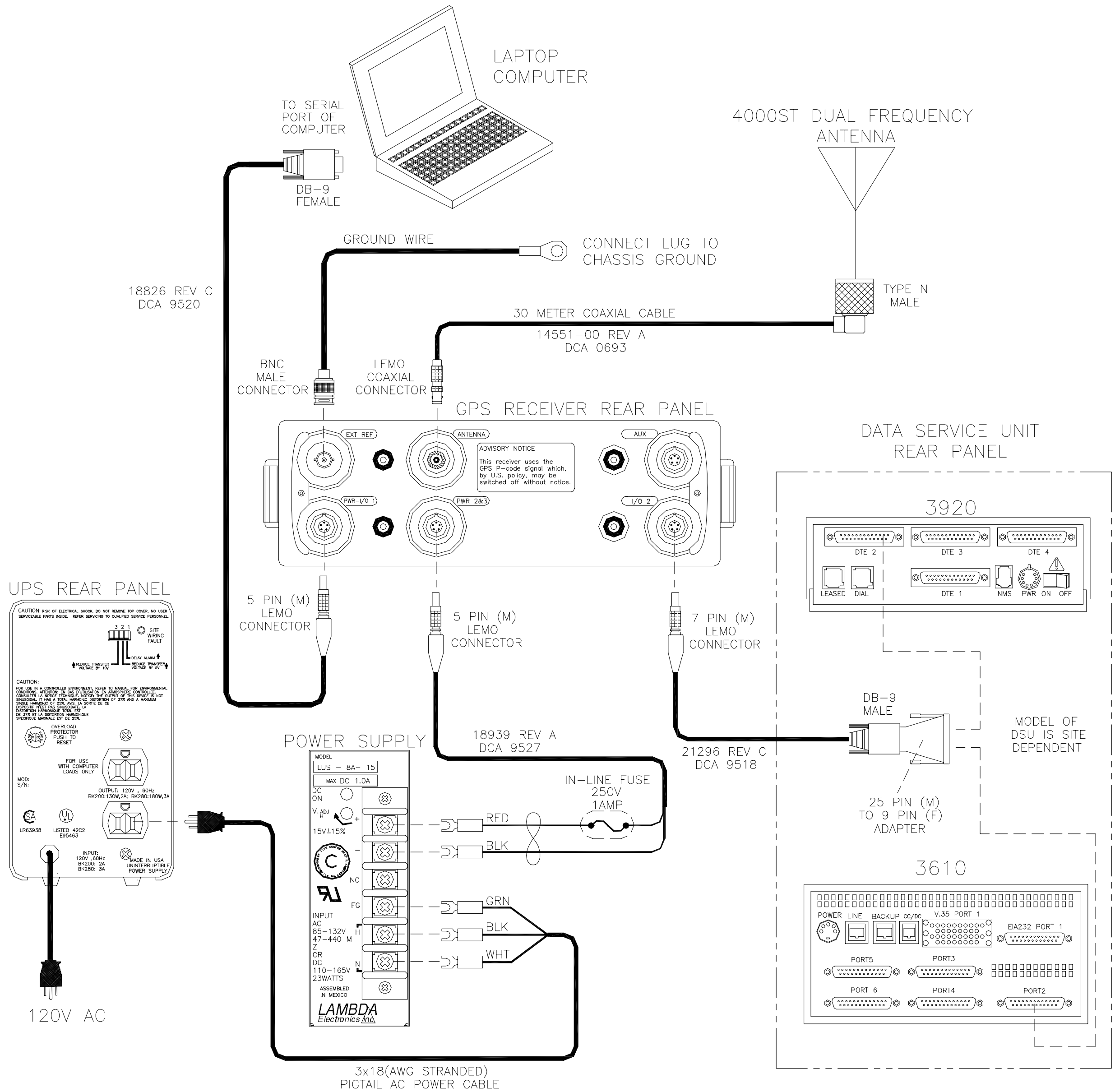

Figure 11-10 GPS-IPW System Cabling Diagram

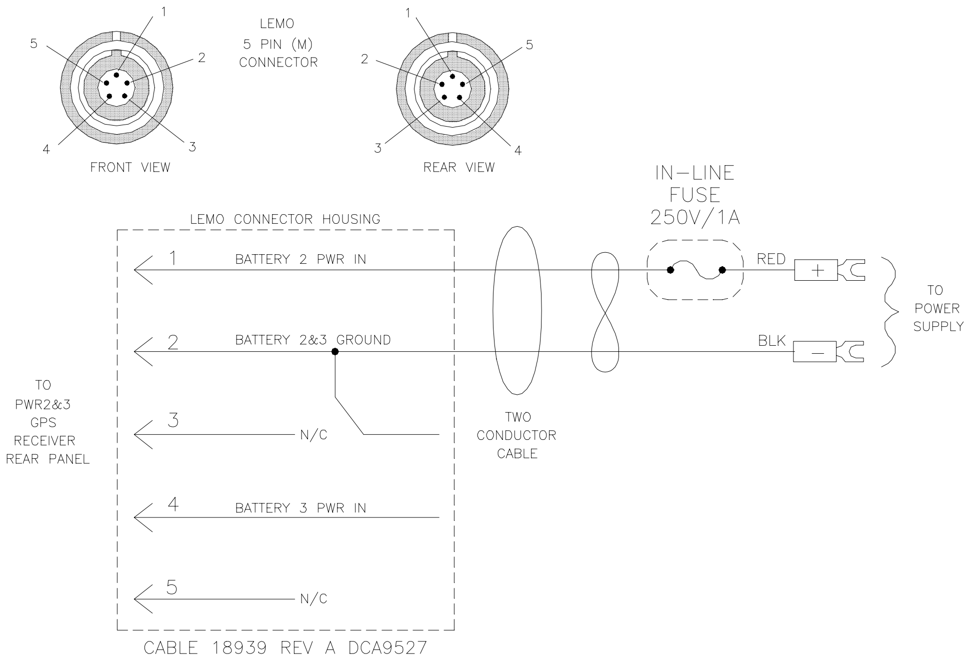

Figure 11-11 GPS Receiver Power Cable Specifications

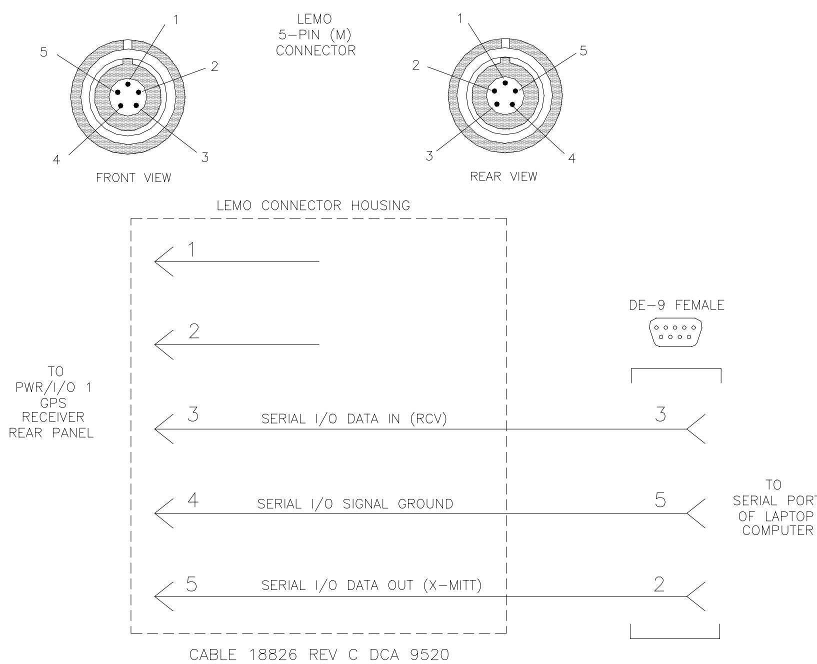

Figure 11-12 GPS Receiver DCE Cable Specifications

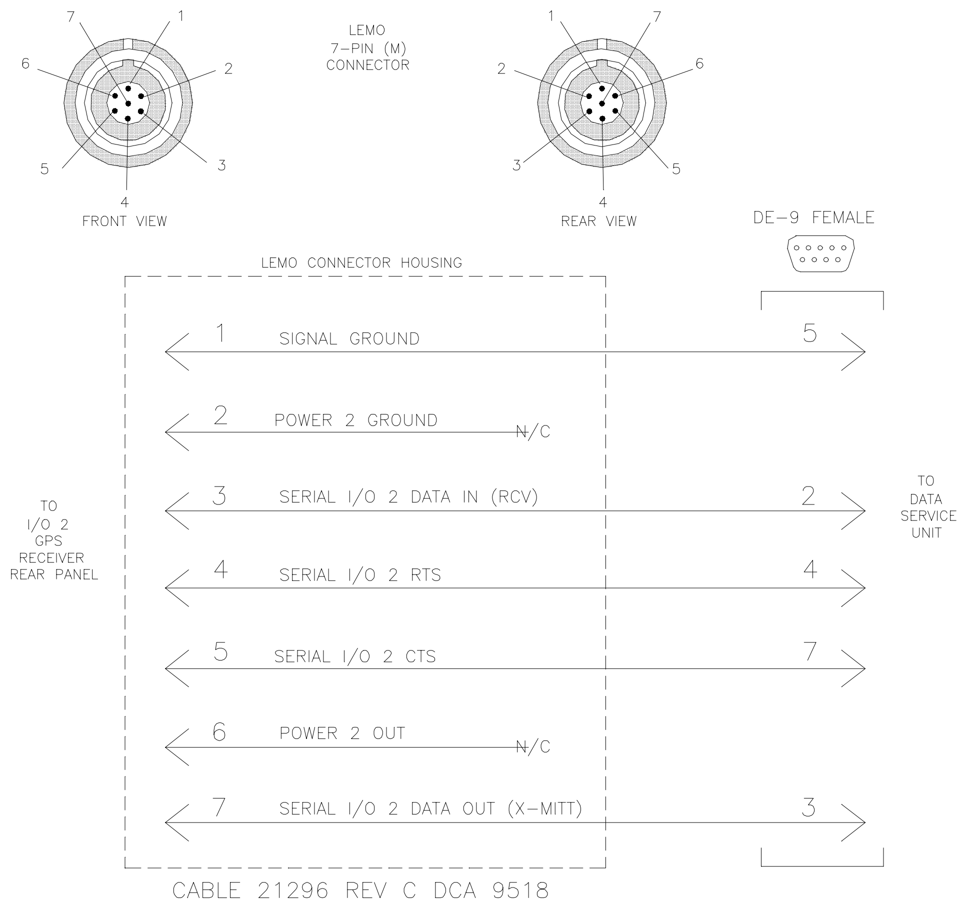

Figure 11-13 GPS Receiver DTE Cable Specifications

11.2 Operations

11.2.1 Determining Receiver & Antenna Health and Status

GPS receiver and antenna operation is verified by viewing the receiver STATUS display. The STATUS display is accessed by pressing the *STATUS* key on the GPS receiver front panel. Figure 11-14 is a sample STATUS display of a working receiver and antenna. The major indicators are described below.

Number of satellites visible to the receiver. A working receiver should track multiple satellites at any given time. In the example in Figure 11-14, the third line ***SV05, 30, 06, 10, 26, 13, 17*** indicates seven (7) satellite vehicles (SV) are currently visible to the receiver. If the receiver is not tracking satellites, there is a problem with the receiver, antenna, or antenna cable.

Session Minute: The receiver is programmed to collect 48 one-half hour sessions of data per day. Sessions begin at the top of the hour, and at 30-minutes past the hour. In this example, the receiver has been logging data for 12 minutes (out of 30 minutes).

Antenna Continuity Symbol: This icon (resembling a yield sign) indicates the receiver detects an antenna. If this icon is not present, there may be a problem with the antenna or antenna cable.

Battery Voltage: Indicates that DC power is being supplied on ***PWR 2&3*** and the battery level is at optimum level. Since the receiver is powered from a DC power supply, the DC level indicator should always indicate optimum battery level.

Current Time: The receiver acquires its time from the GPS satellites (*hh:mm:ss UTC*). If the receiver does not have a solid lock on the satellites, the time display reverts to *hh:mm*. If seconds are not visible on the display, a problem with the receiver, antenna, or antenna cable may exist.

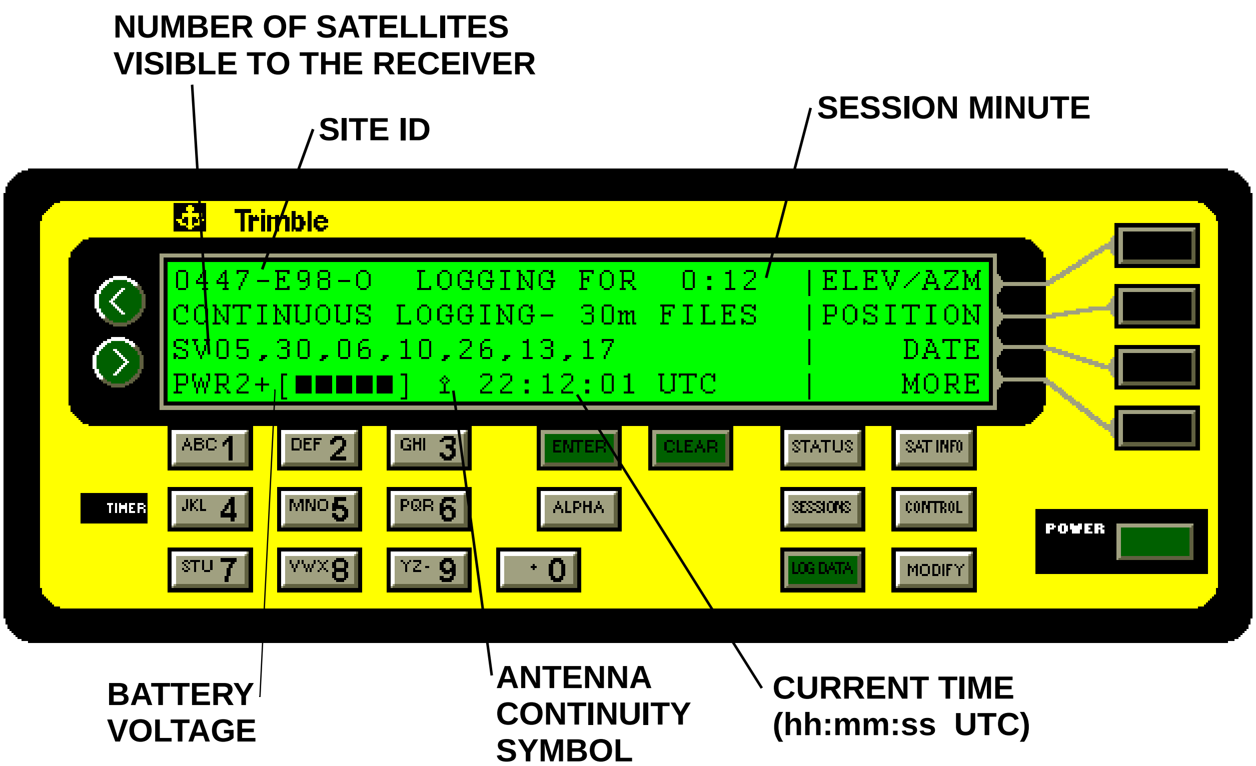

Figure 11-14 GPS Receiver Front Panel Status Display

11.2.2 Starting Survey

1. Press the ***LOG DATA*** key on the GPS receiver Front Panel, the following menu options are displayed.

```
     QUICK-START NOW! (SINGLE SURVEY) --
    START PRE-PLANNED (SINGLE SURVEY) --
START FAST STATIC OR KINEMATIC SURVEY --
                                 MORE --
```

2. Select ***QUICK-START NOW! (SINGLE SURVEY) --*** from the display options (press black key to right of display). The receiver starts the survey and the display changes to the STATUS display.

11.2.3 Ending Survey

1. Press the ***LOG DATA*** key on the Trimble Front Panel. The following options are displayed.

```
SURVEY:                     |USER INPUT
                            |   CHANGES
                            |
                            |END SURVEY
```

2. Select ***END SURVEY*** from the display options (press black key to right of display).

```
                                 | YES
  STOP THE CURRENT SURVEY ?      |
                                 |
                                 |  NO
```

3. Select ***YES*** from the display options (press black key to right of display). The receiver ends the current survey and the display changes to the STATUS display.

11.2.4 GPS Receiver Re-initialization (Hard Reset)

Occasionally a GPS receiver's memory can become corrupt and cause the receiver to behave erratically. Many times, this type of problem can cleared by re-initializing the GPS receiver.

1. Press the ***LOG DATA*** key on the Trimble Front Panel. If the receiver is currently surveying, the following options are displayed. If the GPS receiver is not currently surveying, go to Step 3 below.

.

```
SURVEY:                                    |USER INPUT
                                           |   CHANGES
                                           |
                                           |END SURVEY
```

2. Select ***END SURVEY*** from the display options (press black key to right of display).

```
                                                | YES
  STOP THE CURRENT SURVEY ?                     |
                                                |
                                                |  NO
```

3. Select ***YES*** to confirm ending survey. Press and hold down the ***POWER*** key on the Trimble front panel until the receiver powers-down.

4. Press and hold down the ***CLEAR*** and ***LOG DATA*** and ***POWER*** keys simultaneously, until the receiver beeps. The following message should appear on the display:

```
 4000SSi GEODETIC SURVEYOR     |CLEAR ALL
          TEST MENU            |
        SETUP/CONTROL          |
                               |
```

5. Select ***CLEAR ALL*** from the display (press black key to right of display) The following message will appear on the display.

```
           CLEAR MEMORY                 |
CAUTION: PRESSING <YES> WILL CAUSE      | YES
ALL NON-VOLATILE RAM TO BE ERASED!!     |
RECEIVER WILL RESTART                   |  NO
```

6. Select ***YES*** from the display options (press black key to right of display). The receiver restarts, and goes through its normal boot cycle.

Re-initializing the GPS receiver will cause stored parameters to be lost. See Section 11.2.5 and Section 11.2.6 for information about configuring communications and survey parameters.

11.2.5 Configuring Communications Parameters

1. Press the ***CONTROL*** key on the Trimble front panel, the following message will appear on the display.

```
               CAUTION!
 MODIFYING CERTAIN CONTROL PARAMETERS
    MAY CAUSE LOSS OF LOGGED DATA!
PRESS CONTROL TO CONTINUE, CLEAR TO EXIT
```

2. Press the ***CONTROL*** key again to continue. The following message appears on the display.

```
RECEIVER CONTROL:    | LOGGED DATA FILES
(1 OF 6)             |  POWER-UP CONTROL
                     | SV ENABLE/DISABLE
                     |              MORE
```

3. Select ***MORE*** from the display options (press black key to right of display). The following message appears on the display.

```
RECEIVER CONTROL:      | ADJUST LOCAL TIME
(2 OF 6)               |   BAUD RATE/FORMAT
                       |    REMOTE PROTOCOL
                       |               MORE
```

4. Select ***BAUD RATE/FORMAT*** from the display (press black key to right of display). The following options appear on the display

:

```
        SERIAL PORT 1 SETTINGS <- CHANGE
        SERIAL PORT 2 SETTINGS <- CHANGE
```

5. Select ***SERIAL PORT 1 SETTINGS*** or ***SERIAL PORT 2 SETTINGS*** from the display options (press black key to right of display). The following parameter options appear on the display.

```
 PORT 1 BAUD RATE [    4800   ] <- CHANGE
           FORMAT [ 8-NONE-1 ] <- CHANGE
     FLOW CONTROL [   NONE    ] <- CHANGE
```

6. Change ***BAUD RATE*** to ***4800*** by pressing the corresponding black key (to right of display) repeatedly until the desired baud rate is displayed.

7. Change ***FORMAT*** to ***8-NONE-1*** by pressing the corresponding black key (to right of display) repeatedly until the desired setting is displayed.

8. Change ***FLOW CONTROL*** to ***NONE*** by pressing the corresponding black key (to right of display) repeatedly until the desired setting is displayed.

9. Repeat this process for Port 1 and Port 2.

11.2.6 Configuring Survey Parameters

1. Press the ***LOG DATA*** key.

2. Select ***MORE*** from the display (press black key to right of display).

3. Select ***SETUP SURVEY CONTROLS*** from the display (press black key to right of display).

4. Select ***MODIFY QUICKSTART CONTROLS*** from the display (press black key to right of display).

5. Select ***MORE*** from the display (press black key to right of display). The following options appear on the display.

```
QUICKSTART CONTROLS                  |MORE
CONTINUOUS LOGGING:  ON              |CHANGE
LOG FILE DURATION: 0030 minutes      |CHANGE
                                     |
```

6. Set ***CONTINUOUS LOGGING*** = ***ON*** by pressing the *CHANGE* key to the right of the display.

7. Set ***LOG FILE DURATION*** = ***0030 minutes*** by repeatedly pressing the corresponding black key to the right of the display.

8. Commit the changes by pressing the green ***ENTER*** key. The display will change to the next page of *QUICKSTART CONTROLS*.

```
QUICKSTART CONTROLS                  |MORE
STORE POSITION:   NORMALLY           |CHANGE
ELEVATION MASK:+07°  MIN SVs: 01     |MINUS
MEAS SYNC TIME: 030.0 SEC            |ACCEPT
```

9. Set ***STORE POSITION*** = ***NORMALLY*** by pressing the *CHANGE* option key on the right side of the display.

10. Set ***ELEVATION MASK*** = **+07°**. Press the green arrow keys (left side of display) to move the cursor position. Press the black key to the right of the display to change the polarity (+/-). Press the numeric keys to enter the values.

11. Set ***MIN SVs*** (minimum satellite vehicles) = **01**

12. Set ***MEAS SYNC TIME*** = **030.0 SEC**

13. Select ***ACCEPT*** from the display options (press black key to the right of display)

11.2.7 Upgrading the GPS Receiver Firmware

Periodically, enhancements and revisions are made to the Trimble receiver firmware. Rather than changing-out the receiver hardware, the receiver's firmware can by updated on site by running a DOS program that re-flashes the program memory.

Acquiring the Firmware Upgrade

The firmware updates are down-loaded from the NOAA GPS-IPW Web page:

http://www-dd.fsl.noaa.gov/gps/gps_support/

If Web access is not available to you, contact the Profiler Control Center at 303-497-6033 for an alternative method to acquire the firmware upgrade.

Once you have reached the Web page, click the FTP Icon and down-load the self extracting zip file to your local machine. Extract the files from the zip archive to a temporary directory (note the self-extraction program requires *Microsoft NT or Windows 95* or greater.) Copy the extracted files to a 3.5" 1.44 MByte floppy diskette.

*** NOTE ***

The PMT computers located at most of the profiler sites do not support 1.44 MByte diskette format. The minimum computer hardware requirements to perform the GPS Receiver Firmware Update are:

- DOS or Windows Operating system
- (1) - 3.5" 1.44 MByte Floppy Disk drive
- (1) - 9-pin Serial Communications Port (COM1 or COM2)
- (1) - DE-9 pin (M) to DB-25 pin (F) adapter (if the notebook computer has a 25 pin (M) serial port.)

Updating the Firmware

1. Press the ***LOG DATA*** key on the Trimble GPS receiver front panel.

2. Select ***END SURVEY*** from the display options (press black key to right of display).

3. Select ***YES*** from the display options (press black key to right of display).

4. Power-down the Trimble GPS Receiver by pressing and holding the ***POWER*** key.

5. Place the notebook computer near to the GPS receiver.

6. Connect the GPS ***PWR-I/O 1*** communications interface cable to the notebook computer's serial port (preferably COM1, but COM2 will work also.) Refer to Figure 11-10 for cabling diagram.

7. Power-up the GPS receiver and wait for it to complete its boot sequence.

If the notebook computer has a hard disk-drive, create a directory called **`C:\gps_fw`**. Copy the upgrade files from the floppy diskette to **`C:\gps_fw`**. Change directory (CD) to **`C:\gps_fw`**.

8. From the DOS prompt on the Notebook computer, type one of the following command:

UPDATE 1 <Enter>	(if notebook serial port COM1 is being used)
UPDATE 2 <Enter>	(if notebook serial port COM2 is being used)

As the *UPDATE* program begins to execute, it tries to auto-detect the GPS receiver's communications parameter settings (refer to line 3 in Figure 11-15). If the program is able to auto-detect the parameters, the program proceeds to completion (lines 4 - 16 in Figure 11-15). During the update process, the GPS receiver displays the message ***REMOTE MONITOR ACTIVE***.

If the *UPDATE* program seems to get stuck at line 3 (referring to Figure 11-15), the program was unable to auto-detect the receiver's communications parameters. If this happens, the notebook computer will need to be rebooted or power-cycled to break-out of the *UPDATE* program. To remedy this problem, try changing the *baud rate* or *parity* setting of *Port 1* on the GPS receiver and repeat step 8 of this procedure. (Refer to Section 11.2.5 for information about configuring GPS receiver communications parameters).

```
1       4000 SE/SSE/SSi & 7400MSi REMOTE MONITOR, V4.32

2       Initializing COM1
3       Finding receiver baud setting.  Trying: 4800 baud, odd parity
4       Establishing link at 4800 baud, odd parity
5       PPU Version = 3.34
6       Receiver Type=05

7       Link established.  Defaulting to 9600 baud, no parity
8       Changing port settings to: 38400 baud, no parity
9       SE/SSE/SSi H/W target receiver detected.
10      HP64000 header name - HP V1.7
11      Code rev = 7.19     Date: 02-Feb-00     Total bytes= 636766
12      Authorized Firmware Version = 7.31

13      DOWNLOAD AUTHORIZED.

14      Writing receiver program....000ABFF (0-100%)
15      Receiver programming completed
16      Done.
        C:\>
```

Figure 11-15 Notebook Computer Display During Update Process

9. Upon successful completion of the firmware upgrade, the GPS receiver reboots, beeps several times and displays the following message:

```
RESTARTED BY
REMOTE MONITOR
ddd dd-mmm-yy  hh:mm GPS
** PRESS CLEAR KEY **
```

Press the green ***CLEAR*** key to continue.

The firmware update process causes the GPS receiver to loose several parameters that will need to be re-entered manually from the receiver front panel. Refer to Section 11.2.5 for procedures for configuring communications parameters. Refer to Section 11.2.6 for procedures for configuring survey parameters.

11.3 GPS-IPW System Troubleshooting

11.3.1 Isolating Faulty Antenna or Receiver

It is often impossible to remotely diagnose specific component failures of the GPS-IPW electronics equipment. When a GPS-IPW system fails, a replacement GPS receiver, GPS antenna, and a 10-meter GPS antenna cable are shipped to the technician who will conduct the maintenance. Specific component failures must be isolated by the on-site technician using a process of elimination. The following procedures and the flowchart shown in Figure 11-16 can be used to isolate faulty GPS receiver, antenna, and/or antenna cable.

1. Connect the 10-meter antenna cable to the replacement GPS antenna and place the antenna on the ground outside the shelter in an area that has a clear view of the sky. Connect the other end of the 10-meter cable to the *ANTENNA* input jack on the rear panel of the existing GPS receiver. Instruct the existing GPS receiver to begin surveying (refer to Starting Survey in Section 11.2.2). Determine if the GPS receiver begins to lock-on to satellites (refer to Section 11.2.1 Determining Receiver Health and Status.)

   If the receiver begins to track satellites, then the existing GPS antenna or antenna cable may be damaged. Try replacing the GPS antenna first. See Section 11.4.2 for GPS antenna replacement procedures.

After the GPS antenna has been replaced, if the GPS receiver still does not lock-on to any satellites, then the existing GPS antenna cables must be replaced. Refer to Section 11.4.3 for GPS antenna cable replacement procedures.

2. If the GPS receiver does not lock-on to any satellites using the new antenna/cable, then the GPS receiver probably damaged and must be replaced. Refer to Section 11.4.1 for GPS receiver replacement procedures.

3. After replacing the GPS receiver, if the new GPS receiver does not lock-on to any satellites, then replace the existing GPS antenna. If the receiver does not lock-on to any satellites after the GPS receiver and GPS antenna have been replaced, then replace the GPS antenna cable.

11.3.2 Power Supply Troubleshooting

1. Check the output of the UPS with a voltmeter, the output should be ~ 110 - 120 VAC. If the UPS is failed, replace the UPS assembly

2. Verify the terminal block screws on the +15 VDC Power Supply Assembly are tightened securely.

3. Check the output voltage of the +15 VDC Power Supply with a voltmeter. If the power supply is failed, replace +15 VDC Power Supply assembly.

4. Inspect in-line fuse in the GPS receiver power cable.

5. Verify that the *LEMO* connector in port ***PWR 2&3*** on the GPS receiver rear panel is fully seated.

11.3.3 Communications Troubleshooting

Normally, the GPS receiver port ***I/O 2*** is connected to ***Port 2*** of a Paradyne Data Service Unit (DSU) through a Null-Modem cable (see Figure 11-10 for cabling diagram). Proper operation of the DSU can be verified by connecting the serial port of a notebook computer to the suspect DSU port using a standard (straight through) RS-232 cable. A terminal program can be used

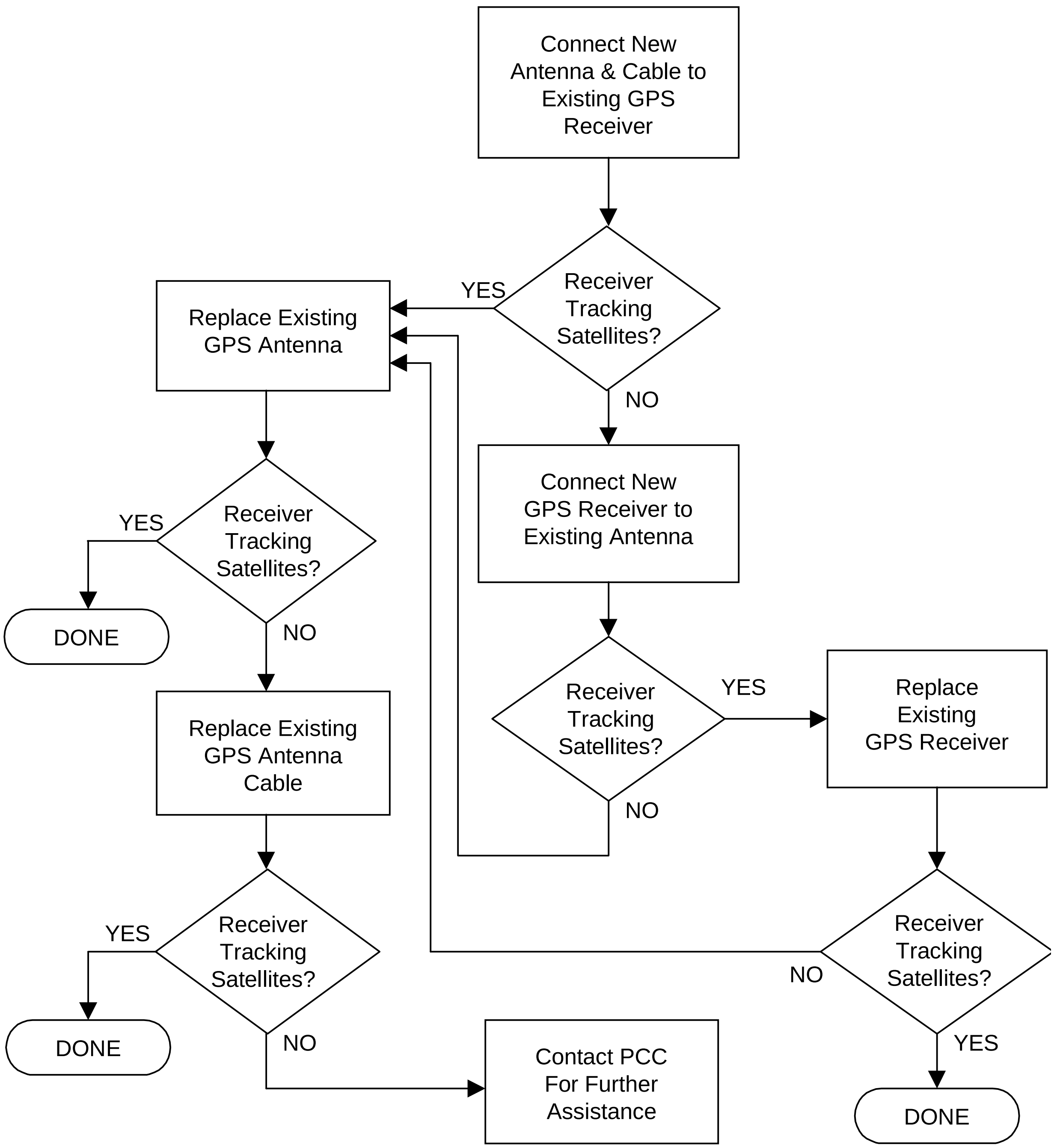

Figure 11-16 GPS Receiver/Antenna Troubleshooting Flowchart

11.4 Replacement Procedures

11.4.1 GPS Receiver Replacement

1. Power-down the GPS electronics assembly by turning off the power switch located on the front panel of the UPS assembly.

2. Loosen the nylon tie-down strap holding the GPS receiver into position.

3. Pull the GPS receiver forward from the 19" rack mount tray just far enough to gain access to the rear panel connections. Disconnect (4) *LEMO* connectors from the receiver by gently pulling the cable connector body straight out from the jack. If the receiver is equipped with a ground wire, disconnect the ground wire's BNC connector from the receiver's *EXT REF* port. Remove the GPS receiver assembly from the rack.

4. Rest the replacement GPS receiver on the rack tray and reconnect the interface cables to the same ports they were removed from. Refer to Figure 11-10 for the GPS system cabling diagram. The *LEMO* connectors are keyed, the connector body should be rotated such that the red dot on the cable connector is directly vertical (toward the top of the receiver). Also, be aware that the *LEMO* connectors have 5-pin and 7-pin configurations, the cable connector can be damaged if it is inserted into the wrong jack.

5. If the receiver is equipped with a ground wire, connect the BNC connector or the ground wire to the EXT REF port of the GPS receiver.

6. Position of GPS receiver in the rack-tray and tighten the nylon tie-down strap.

7. Turn on the power switch on the UPS front panel.

8. Press and hold down the *POWER* key on the front panel of the GPS receiver until the unit beeps and begins its boot sequence. After the GPS receiver has completed boot-up, the following options will appear on the display.

```
      QUICK-START NOW! (SINGLE SURVEY) --
     START PRE-PLANNED (SINGLE SURVEY) --
START FAST STATIC OR KINEMATIC SURVEY --
                                 MORE --
```

9. Select *QUICK-START NOW! (SINGLE SURVEY)*, the GPS receiver will start logging data and the display will switch to the STATUS display. See Section 11.2.1 for information about determining GPS receiver health and status.

10. Contact the PCC at 303-497-6033 to verify communications with the new receiver

11.4.2 GPS Antenna Replacement

11.4.2.1 Replacing GPS Antennas with Radomes

1. Power-down the GPS receiver by pressing and holding down the *POWER* key on the receiver front panel until it shuts down.

2. Remove six nylon screws from the outside of the radome housing. Remove the radome from the antenna.

3. Note the orientation of the arrow symbol on the GPS antenna ground plane. Make a scribe mark on the antenna mount assembly (if one does not already exist) to denote the position of the north arrow. The scribe mark is used as a reference to re-orient the replacement antenna.

4. Disconnect the antenna cable by unscrew the type N connector at the base of the antenna assembly.

5. Unscrew the center bolt that attaches the antenna to the mounting assembly (see Figure 11-7). and remove the antenna from the mount assembly.

6. Remove the six radome mounting adaptors from the failed antenna and transfer them to the replacement antenna. Align the radome mounting adaptors with the edges of the circular indentations on the antenna ground plane as shown in Figure 11-9.

7. Record the serial number of the replacement antenna for later reference.

8. Place the antenna/radome assembly in the mount assembly and thread the center bolt of the mount into the bottom of the antenna.

9. Rotate the antenna/radome assembly so the north arrow on the antenna ground plane aligns with scribe mark on the mount assembly, and firmly secure the center bolt.

10. Check the leveling of the antenna by placing a bubble level in the antenna ground plane. If the antenna is not level, it can changed by adjusting the three leveling bolts as shown in Figure 11-7.

11. Connect the antenna cable to the antenna.

12. Attach the radome cover to the antenna assembly as fasten using six nylon screws.

13. Turn on the GPS receiver by pressing and holding down the POWER key on the receiver front panel until the it beeps.

14. Start the survey using the procedure described in Section 11.2.2. It may take several minutes for the receiver to acquire lock on satellites. See Section 11.2.1 for determining receiver health and status.

11.4.2.2 Replacing GPS Antennas without Radomes

1. Power-down the GPS receiver by pressing and holding down the *POWER* key on the receiver front panel until it shuts down.

2. Note the orientation of the arrow symbol on the GPS antenna ground plane. Make a scribe mark on the antenna mount assembly (if one does not already exist) to denote the position of the north arrow. The scribe mark is used as a reference to re-orient the replacement antenna.

3. Disconnect the antenna cable by unscrew the type N connector at the base of the antenna assembly.

4. Unscrew the center bolt that attaches the antenna to the mounting assembly (see Figure 11-7). and remove the antenna from the mount assembly.

5. Record the serial number of the replacement antenna for later reference.

6. Place the replacement GPS antenna assembly in the mount assembly and thread the center bolt of the mount into the bottom of the antenna.

7. Rotate the antenna assembly so the north arrow on the antenna ground plane aligns with scribe mark on the mount assembly and firmly secure the center bolt.

8. Check the leveling of the antenna by placing a bubble level in the antenna ground plane. If the antenna is not level, it can changed by adjusting the three leveling

bolts as shown in Figure 11-7.

9. Connect the antenna cable to the GPS antenna.

10. Turn on the GPS receiver by pressing and holding down the POWER key on the receiver front panel until the it beeps.

11. Start the survey using the procedure described in Section 11.2.2. It may take several minutes for the receiver to acquire lock on satellites. Refer to Section 11.2.1 to determine receiver health and status.

11.4.3 GPS Antenna Cable Replacement

1. Power-down the GPS receiver by pressing and holding down the ***POWER*** key on the receiver front panel until it shuts down.

2. Remove the right side panel from the Beam Steering Unit (BSU) Cabinet. Remove the blank front panel below the BSU chassis assembly.

3. Pull Power Supply #1 chassis and Power Supply #2 chassis out from the Equipment Cabinet.

4. Disconnect the antenna cable from the rear panel of the GPS receiver.

5. Un-spool the excess GPS cable inside the Equipment/BSU Cabinets and straighten the cable length so it can be pulled from underneath the shelter.

6. From underneath the shelter, loosen the cable gland (or remove duct-seal) from the stuffing tube that the GPS antenna cable passes through.

7. Gentle pull the GPS antenna cable out the bottom the shelter through the stuffing tube.

8. The GPS antenna cable is buried in the gravel between the shelter and the fence. The trench is only inches deep (just enough to cover the cable) and always takes a direct route from the shelter to the fence, similar to route shown in Figure 11-17.

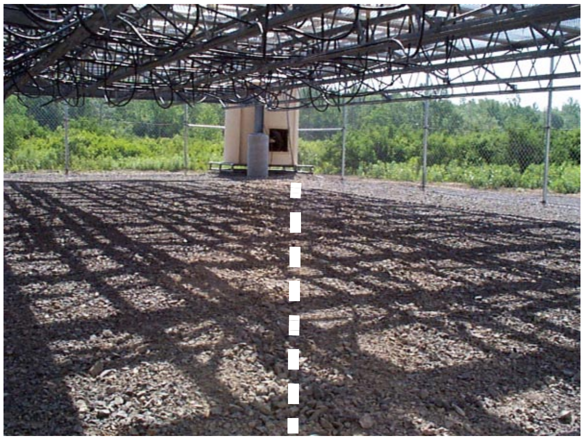

Figure 11-17 GPS Antenna Cable Routing Between Shelter and Antenna

Starting at the shelter, pull up on the antenna cable to lift it out the trench, and work towards the antenna. Once the cable is fully remove from the trench, move the gravel at the base of the fence post to expose the opening to the PVC conduit leading up the fence post to the antenna.

9. Disconnect the cable from the GPS antenna, and pull the entire length of antenna cable out the top of the conduit. This is necessary because the type N connector is too big to pass through the conduit, however, the connector at the other end of the cable will pass through the conduit.

10. Clean out the trench by dragging your heal along the length of the trench, or use a shovel if one is available.

11. Install the replacement antenna cable by feeding the *LEMO* connector through the conduit from the top. Pull the entire cable length through the conduit. Connect the antenna cable's type N connector to the GPS antenna.

12. Lay the antenna cable in the trench (starting at the GPS antenna conduit and work back towards the shelter). Bury the cable in the trench.

13. Feed the antenna cable through the stuffing tube from underneath the shelter. Pull any excess cable length into the shelter and coil the cable inside the Equipment/BSU Cabinets.

14. From underneath the shelter, seal the stuffing tube where GPS antenna cable enters the shelter with Duct-Seal.

15. Connect the GPS antenna cable's *LEMO* connector to the ***ANTENNA*** port on the rear panel of the GPS receiver.

16. Power-on the GPS receiver by pressing and holding down the ***POWER*** key on the receiver front panel until the it beeps.

17. Start the survey using the procedure described in Section 11.2.2. It may take several minutes for the receiver to acquire lock on satellites. Refer to Section 11.2.1 to determine receiver health and status.

11.4.4 Power Supply Replacement

1. Power-down the GPS electronics assembly by turning off the power switch located on the front panel of the UPS assembly.

2. Remove the four mounting screws that fasten the rack-tray to the Equipment Cabinet rails. Pull the rack-tray partially out of the cabinet to access to the power supply assembly.

3. Disconnect the power supply's AC power cord from the UPS receptacle.

4. Loosen the nylon tie-down strap holding the power supply into position.

5. Loosen the screws on the power supply's terminal block and disconnect the cables from the power supply.

6. Connect the AC power cord to the new power supply's terminal block (see Figure 11-10 for wiring diagram). Connect the power cord to the UPS and turn on the UPS. Verify the power supply functions by using a voltmeter to measure the DC output voltage of the power supply.

   If the power supply is outputting 14-15 VDC, turn off the UPS and continue with the installation. If the power supply is not functioning as expected, check the output of the UPS, or check fuses.

7. Connect the DC power cable leads to the power supply terminal block (see Figure 11-10 for wiring diagram).

8. Secure the power supply chassis using the nylon tie-down strap.

9. Mount and secure the rack-tray in the Equipment Cabinet.

10. Turn on the power switch on the front panel of the UPS.

11. Press and hold down the *POWER* key on the front panel of the GPS receiver until the unit beeps and begins its boot sequence. After the GPS receiver has completed boot-up, the following options will appear on the display.

```
     QUICK-START NOW! (SINGLE SURVEY) --
    START PRE-PLANNED (SINGLE SURVEY) --
START FAST STATIC OR KINEMATIC SURVEY --
                                 MORE --
```

12. Select *QUICK-START NOW! (SINGLE SURVEY)*, the GPS receiver will start logging data and the display will switch to the STATUS display. See Section 11.2.1 for information about determining GPS receiver health and status.

11.4.5 UPS Replacement

1. Power-down the GPS electronics assembly by turning off the power switch located on the front panel of the UPS assembly.

2. The UPS's AC power cord is plugged into an outlet power strip at the back of the Equipment Cabinet and is not easily accessible. One method to gain access to this power strip is to remove the top cover panel from the Equipment Cabinet. Another (less feasible) method is to remove the right side panel from the BSU Cabinet and try to reach the power strip from the side. Unplug the UPS's AC power cord from the power strip.

3. Loosen the nylon tie-down strap holding the UPS into position.

4. Reach behind the UPS and disconnect the power supply's AC power cord from the receptacle on the rear panel of the UPS. Pull the UPS assembly out the front of the Equipment Cabinet.

5. Install the replacement UPS and connect the power supply's AC power cord to the receptacle on the rear panel of the UPS.

6. Secure the UPS assembly in the rack-tray with the nylon tie-down strap.

7. Plug the UPS's AC power cord into the AC outlet strip at the back of the Equipment Cabinet. Install cabinet top or side panels as required.

8. Turn on the power switch on the front panel of the UPS.

9. Press and hold down the *POWER* key on the front panel of the GPS receiver until the unit beeps and begins its boot sequence. After the GPS receiver has completed boot-up, the following options will appear on the display.

```
     QUICK-START NOW! (SINGLE SURVEY) --
    START PRE-PLANNED (SINGLE SURVEY) --
START FAST STATIC OR KINEMATIC SURVEY --
                                 MORE --
```

10. Select *QUICK-START NOW! (SINGLE SURVEY)*, the GPS receiver will start logging data and the display will switch to the STATUS display. See Section 11.2.1 for information about determining GPS receiver health and status.

11.5 Preventive Maintenance

11.5.1 Antenna Inspection

Snow Accumulation - During winter months, inspect the GPA antenna assembly for show or ice accumulation on the antenna ground plane (or radome if applicable). Remove any snow or ice from the antenna (or radome).

Mechanical Integrity - Verify the GPS antenna is mounted securely, and the antenna cable connection is tightened sufficiently. Inspect any visible portions of the GPS antenna cable for deterioration or rodent damage. Report any concerns to the PCC.

11.5.2 UPS Functional Test

A functional test of the UPS assembly can be accomplished by removing AC input power from the UPS, and verifying that the GPS receiver continues to operate. Depending on the site, the UPS may draw power from circuit breaker #24 (Data Processor) or circuit breaker # 23 (Modem/Communications).

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APPENDIX A System Cabling Diagrams

System Cabling Diagram and Cabling Diagrams for Multi-Conductor Cables

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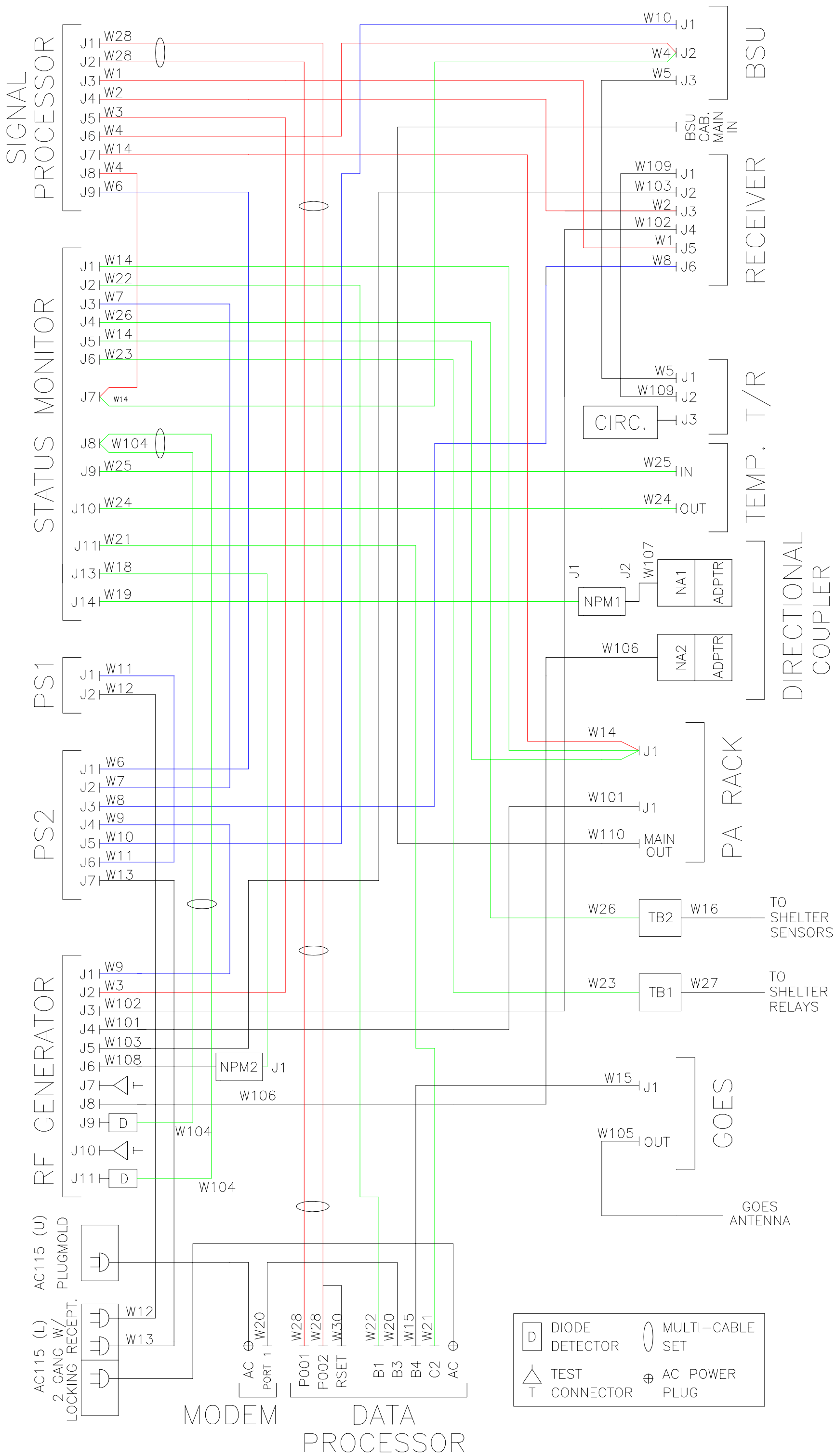

Figure A-1 System Cabling Diagram

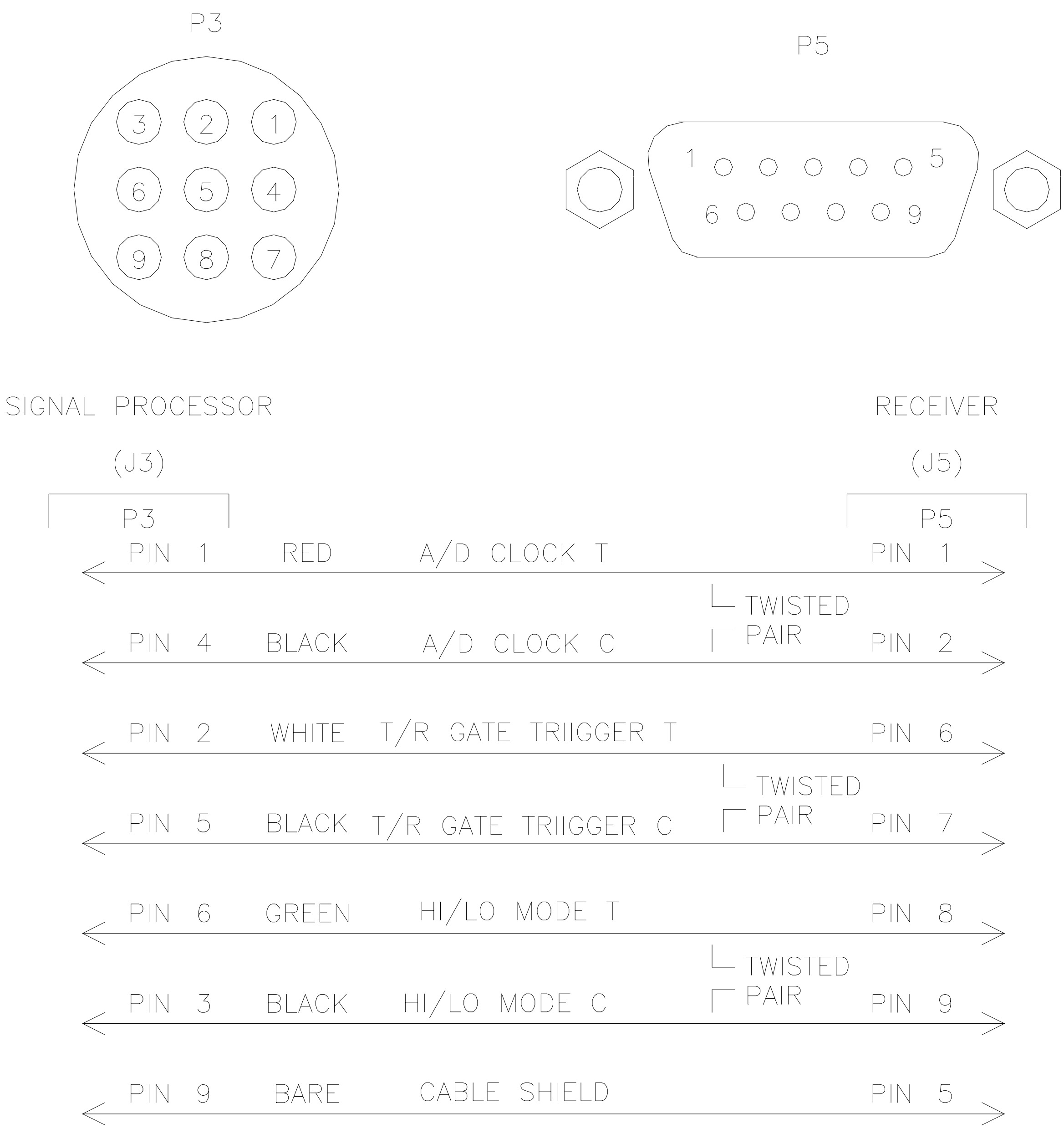

Figure A-2 Cable W1 Wiring Diagram (Signal Processor to Receiver)

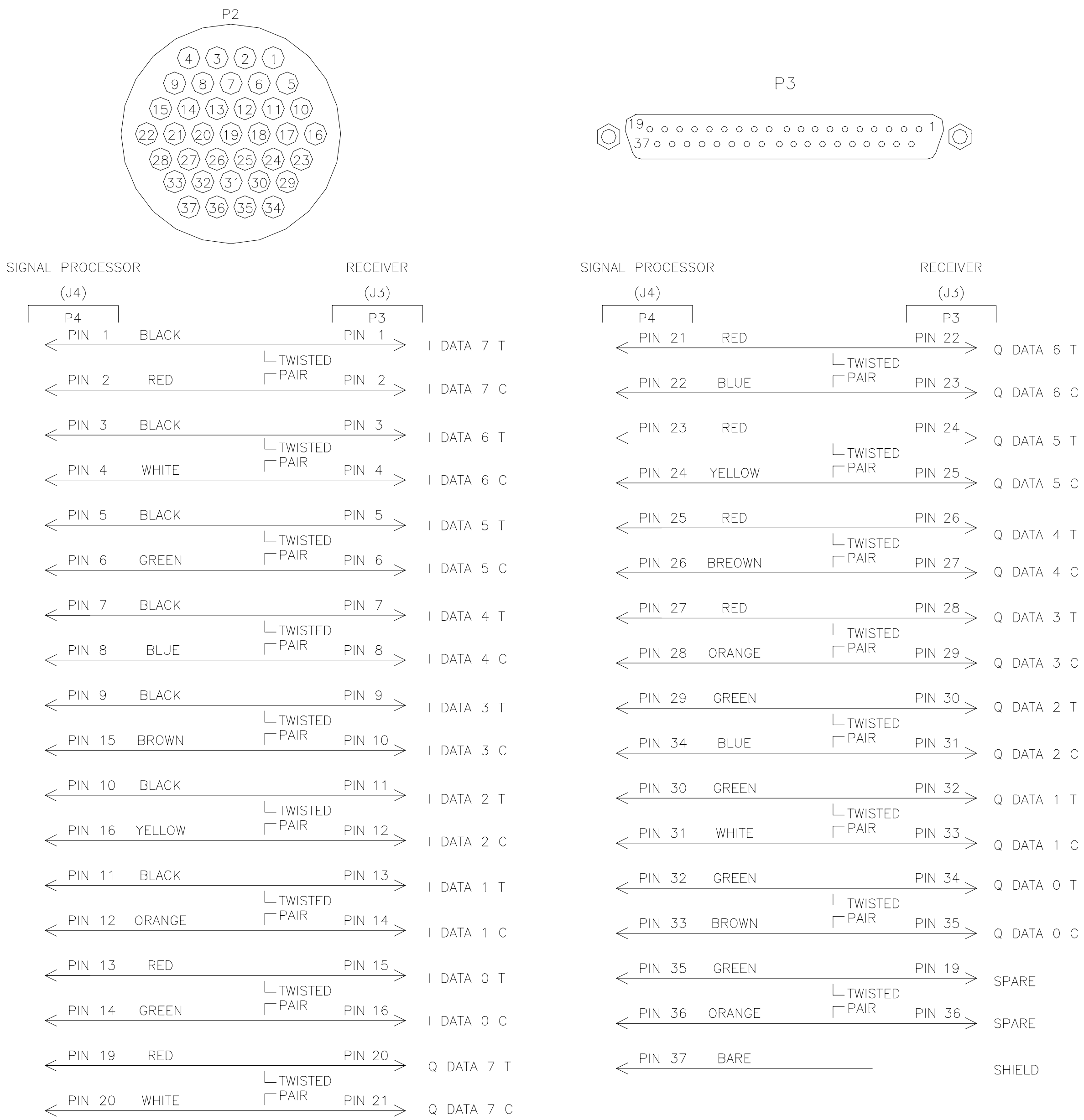

Figure A-3 Cable W2 Wiring Diagram (Signal Processor to Receiver)

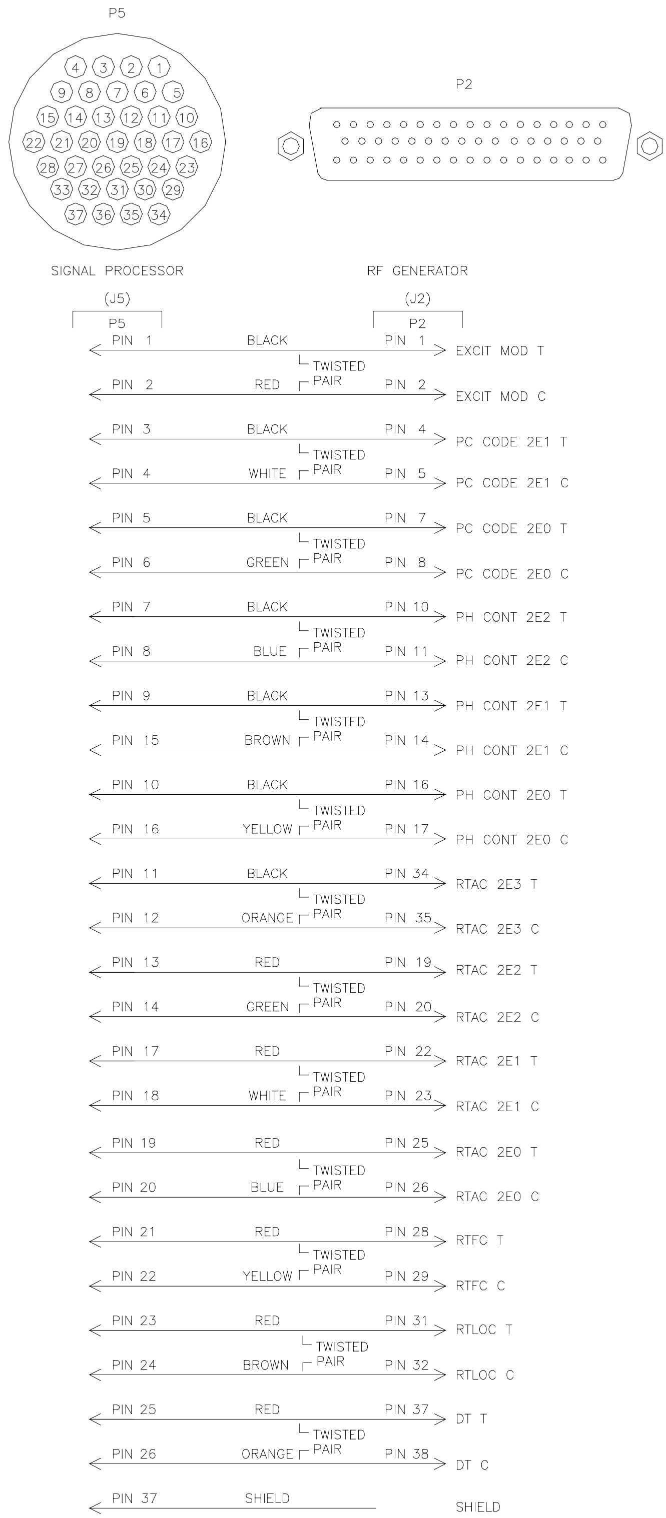

Figure A-4 Cable W3 Wiring Diagram (Signal Processor to RF Generator)

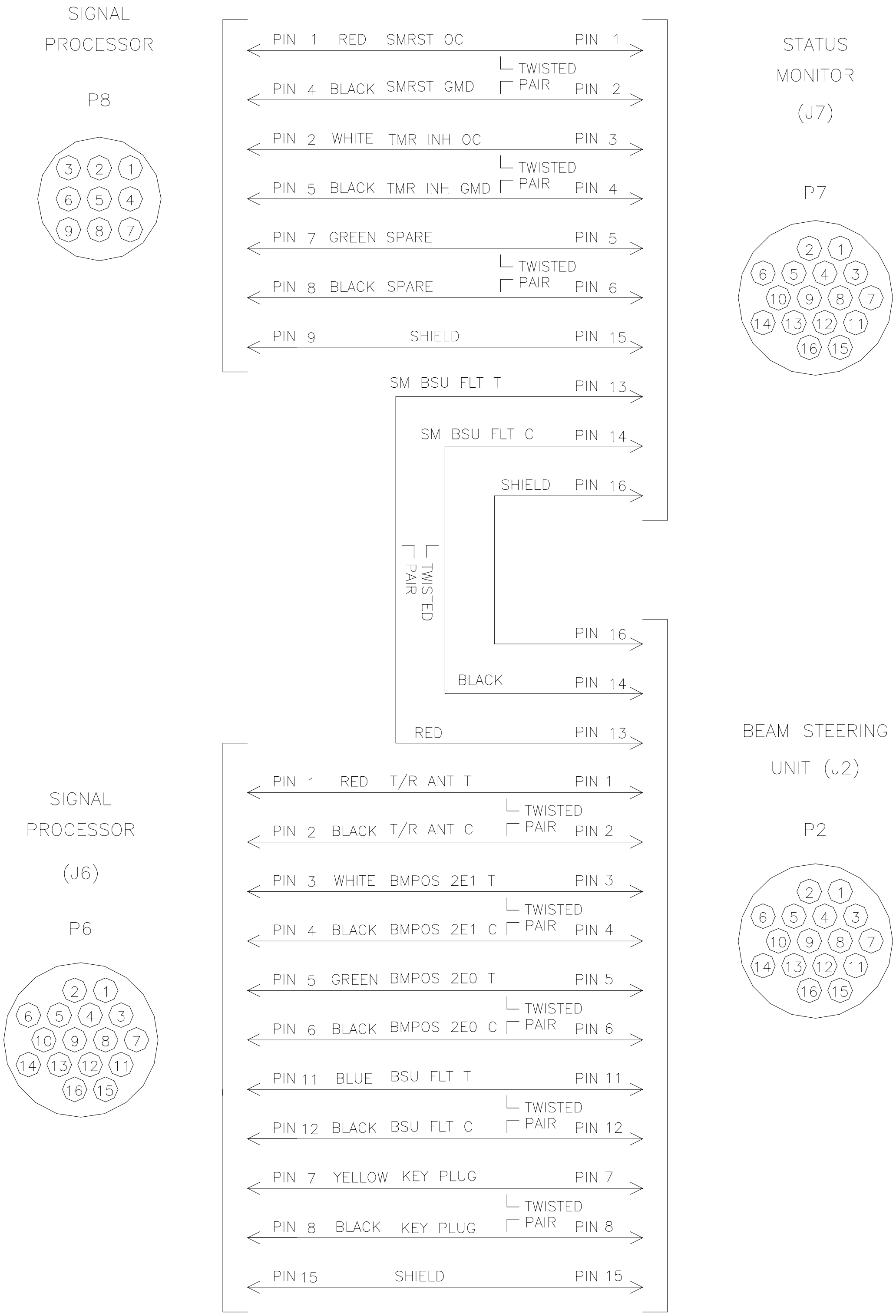

Figure A-5 Cable W4 Wiring Diagram (Signal Processor to BSU)

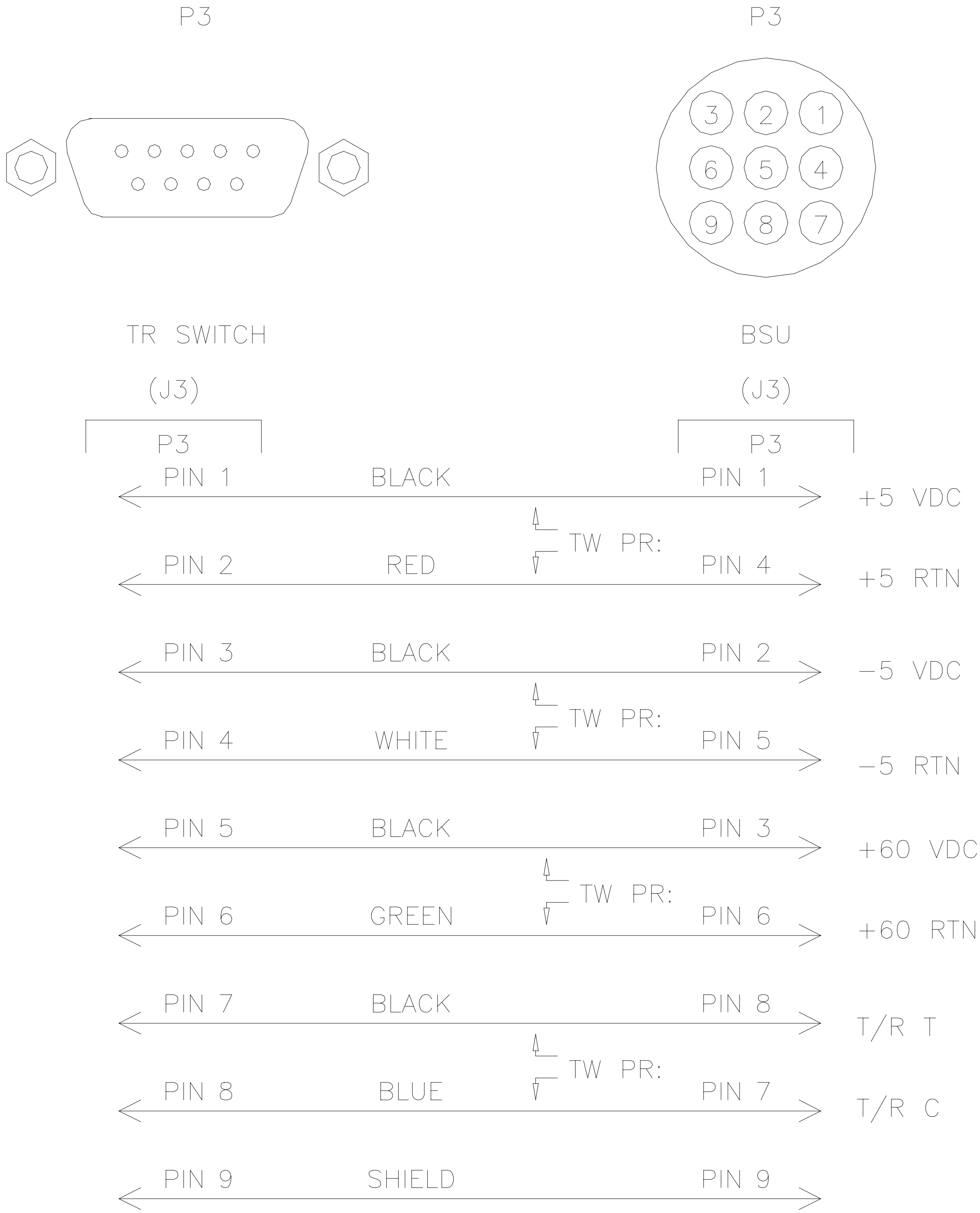

Figure A-6 Cable W5 Wiring Diagram (BUS to T/R Switch)

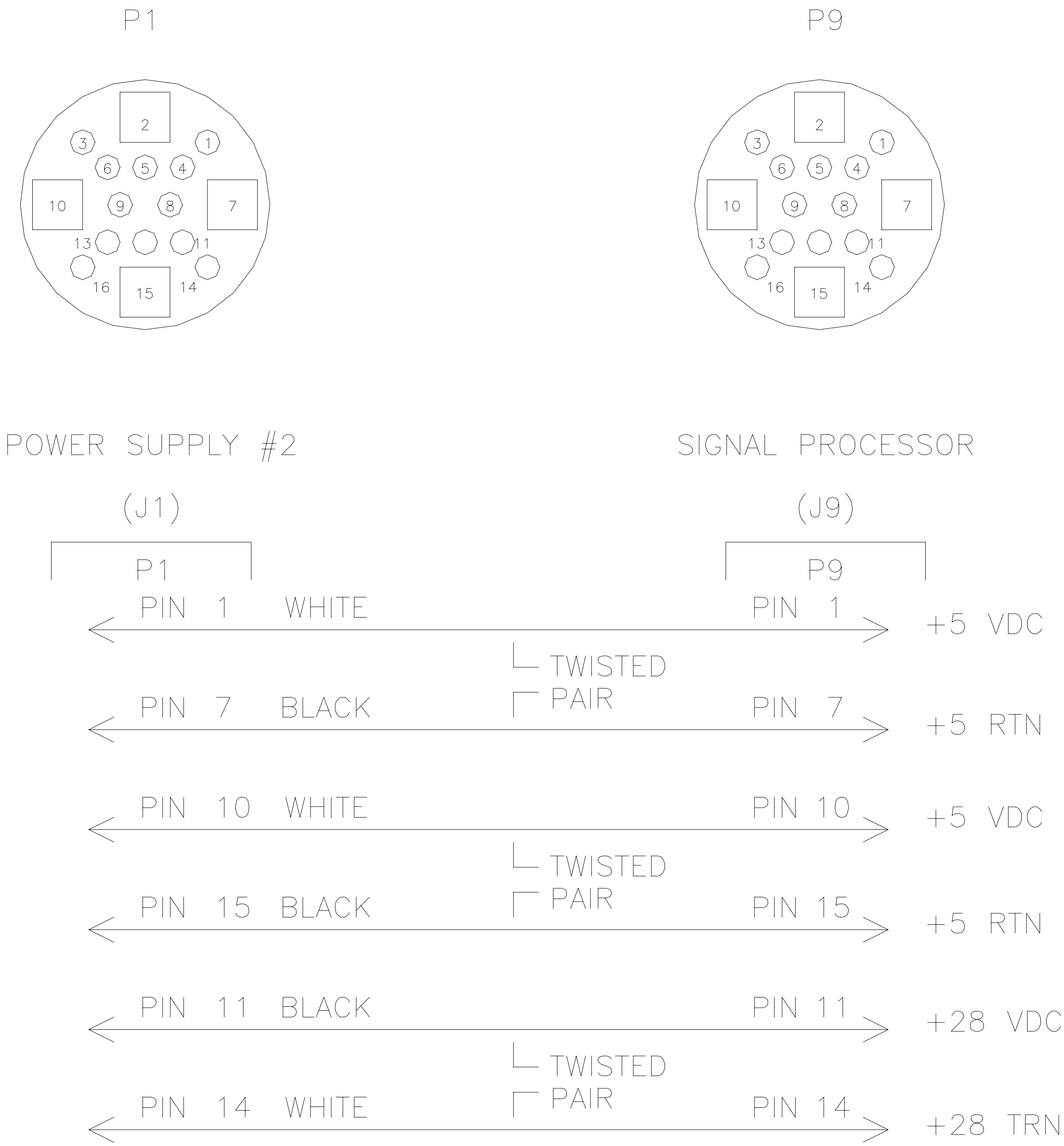

Figure A-7 Cable W6 Wiring Diagram (PS # 2 to Signal Processor)

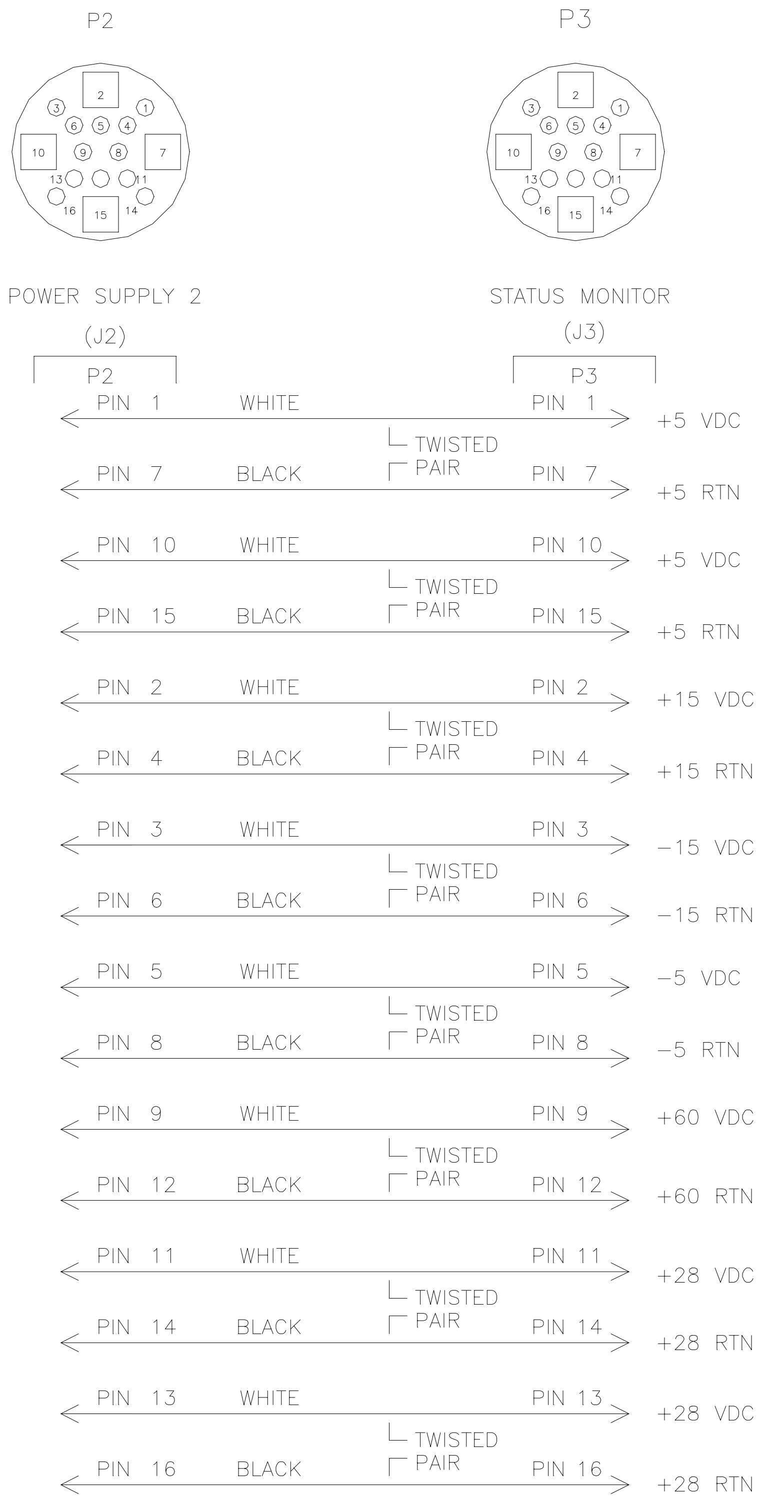

Figure A-8 Cable W7 Wiring Diagram (PS #2 to System Status Monitor)

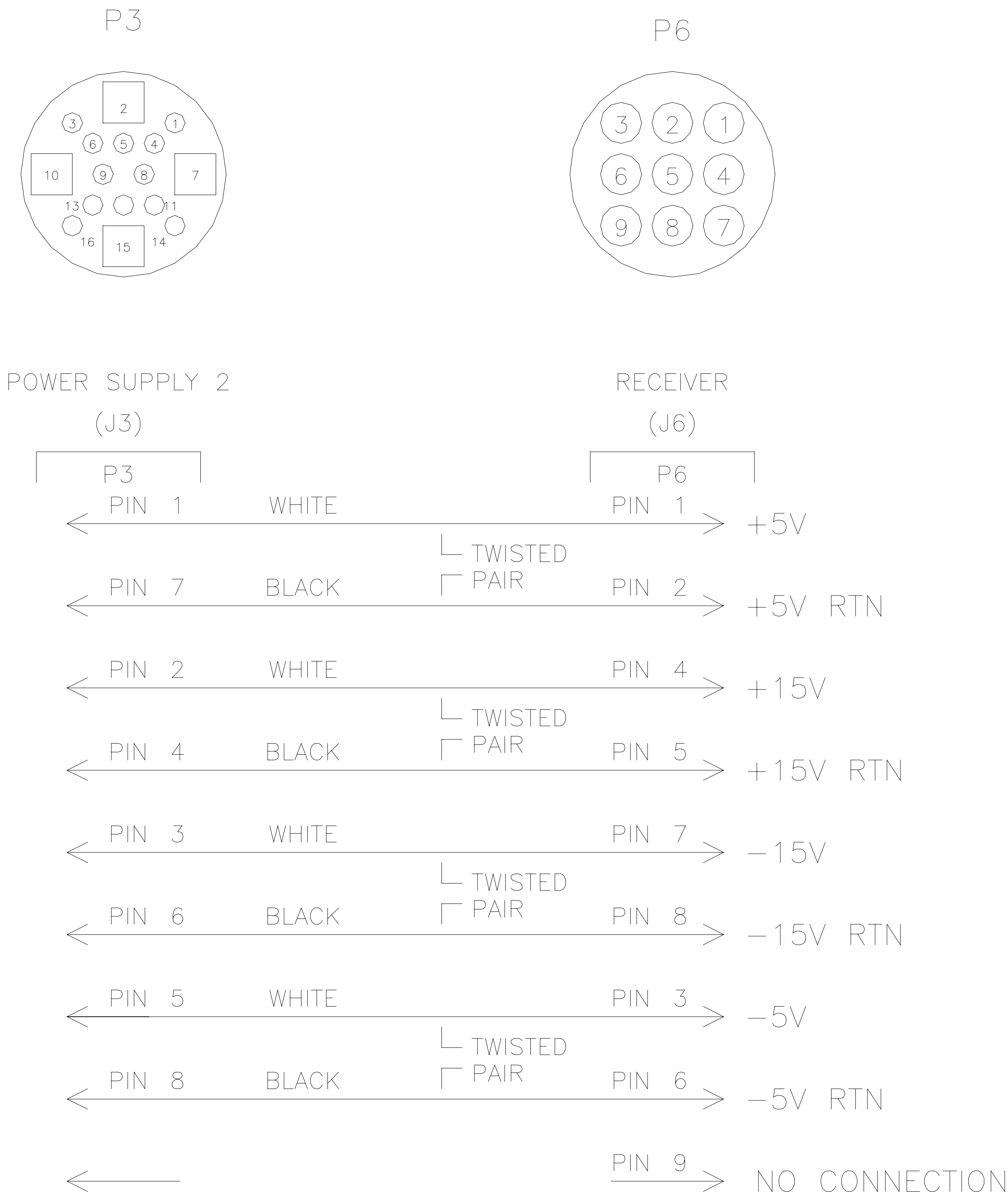

Figure A-9 Cable W8 Wiring Diagram (PS #2 to Receiver)

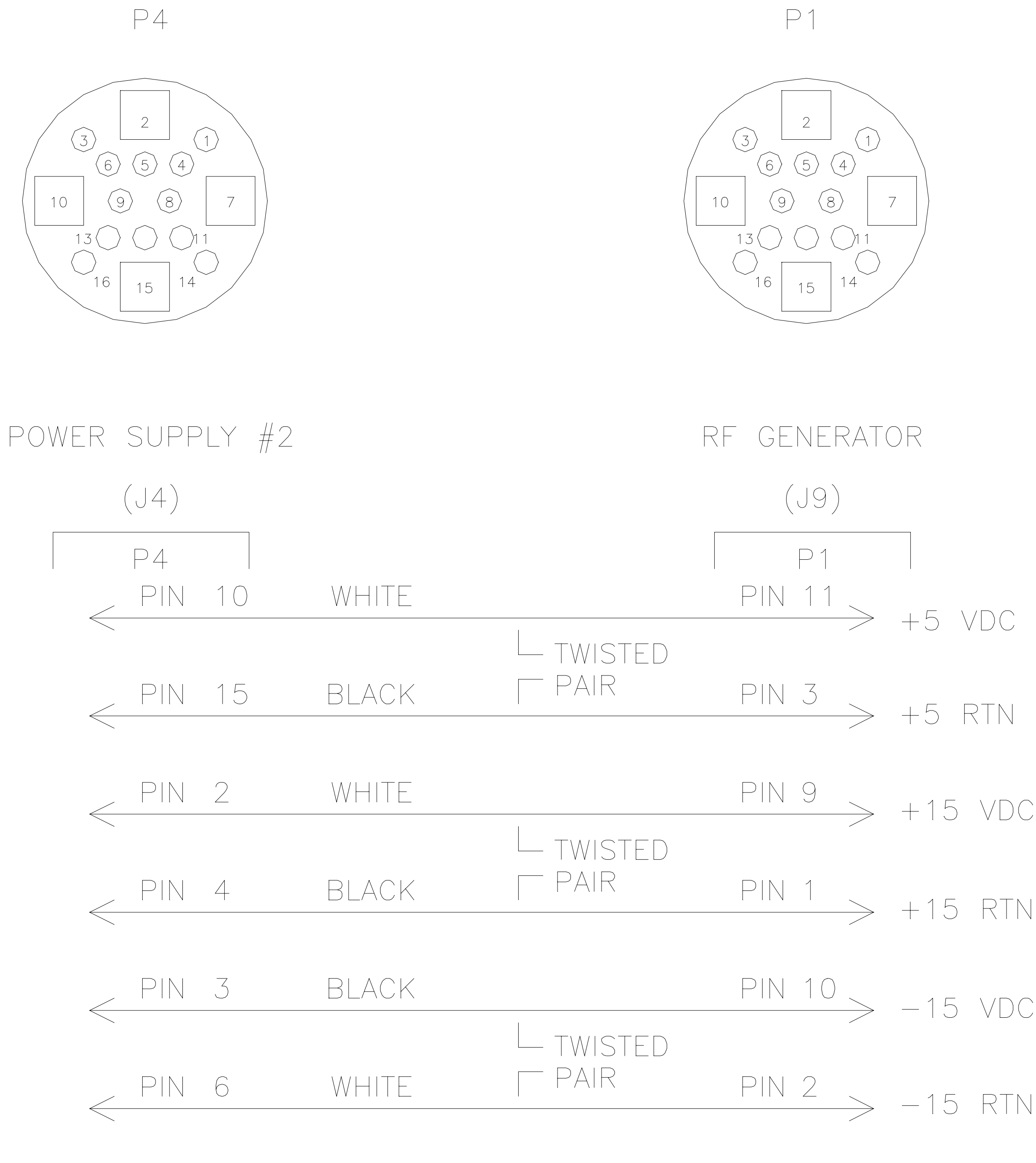

Figure A-10 Cable W9 Wiring Diagram (PS #2 to RF Generator)

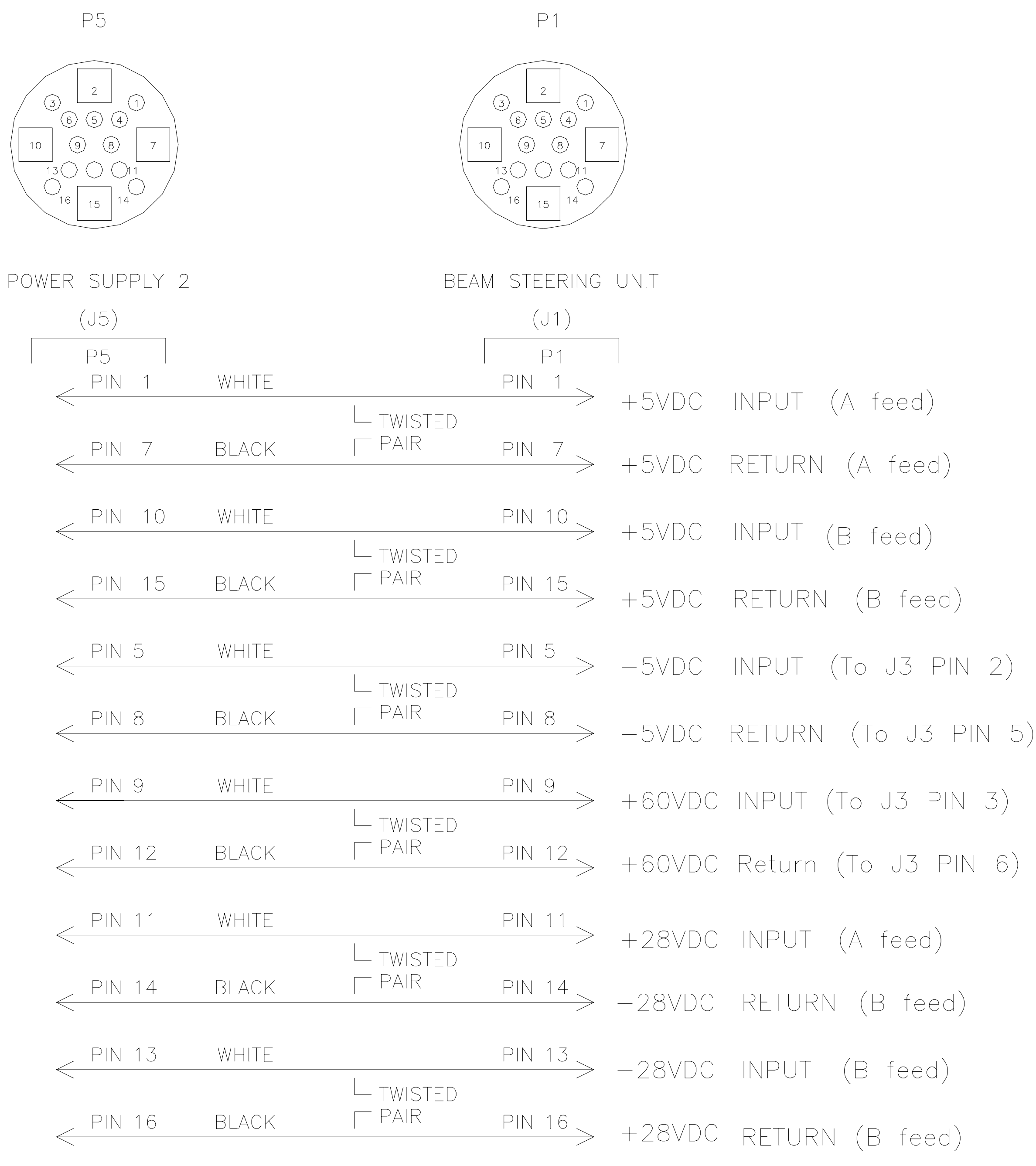

Figure A-11 Cable W10 Wiring Diagram (PS #2 to BSU)

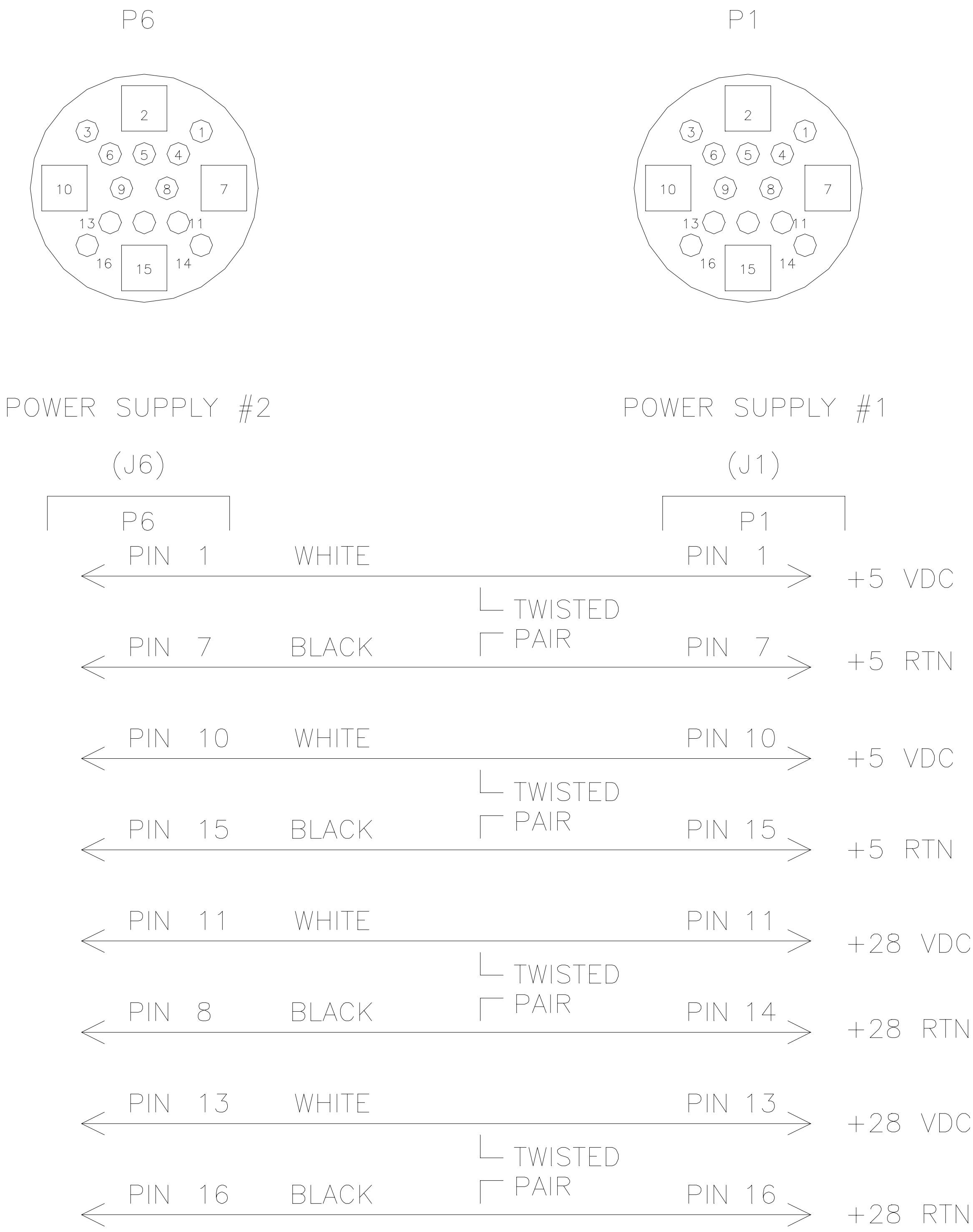

Figure A-12 Cable W11 Wiring Diagram (PS #1 to PS #2)

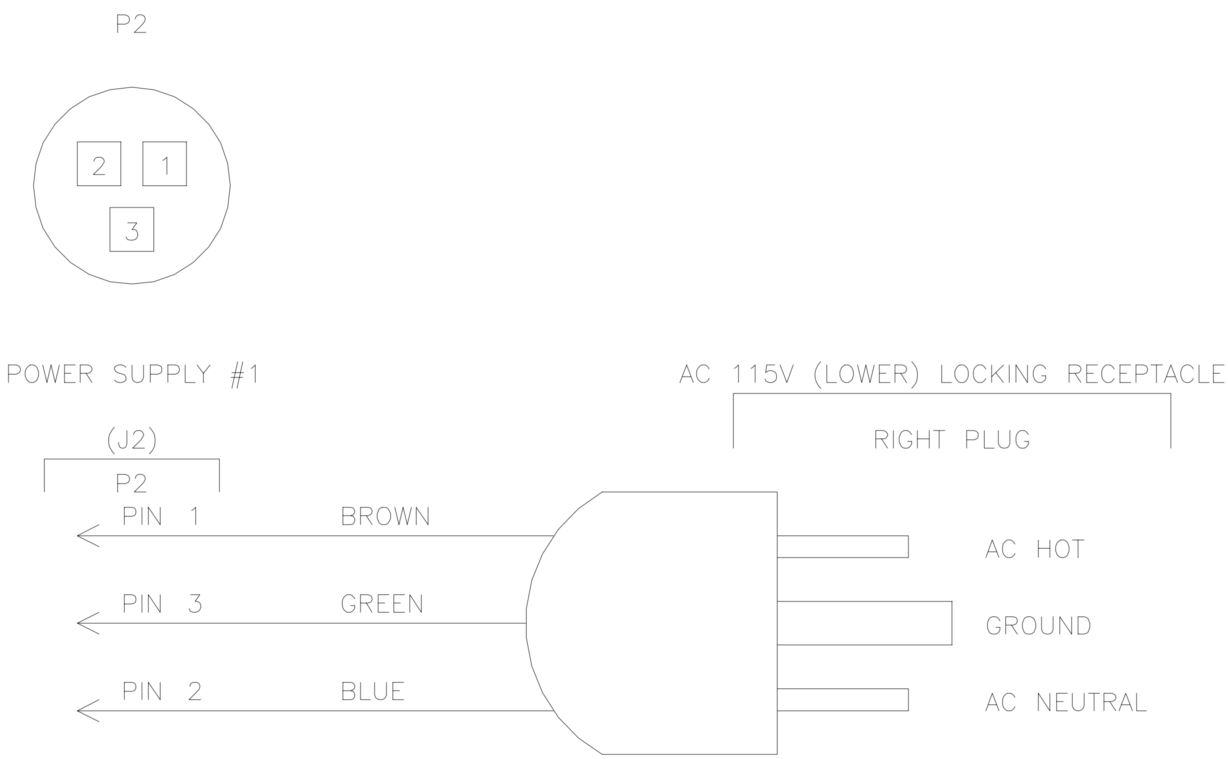

Figure A-13 Cable W12 Wiring Diagram (AC Line Voltage for PS #1)

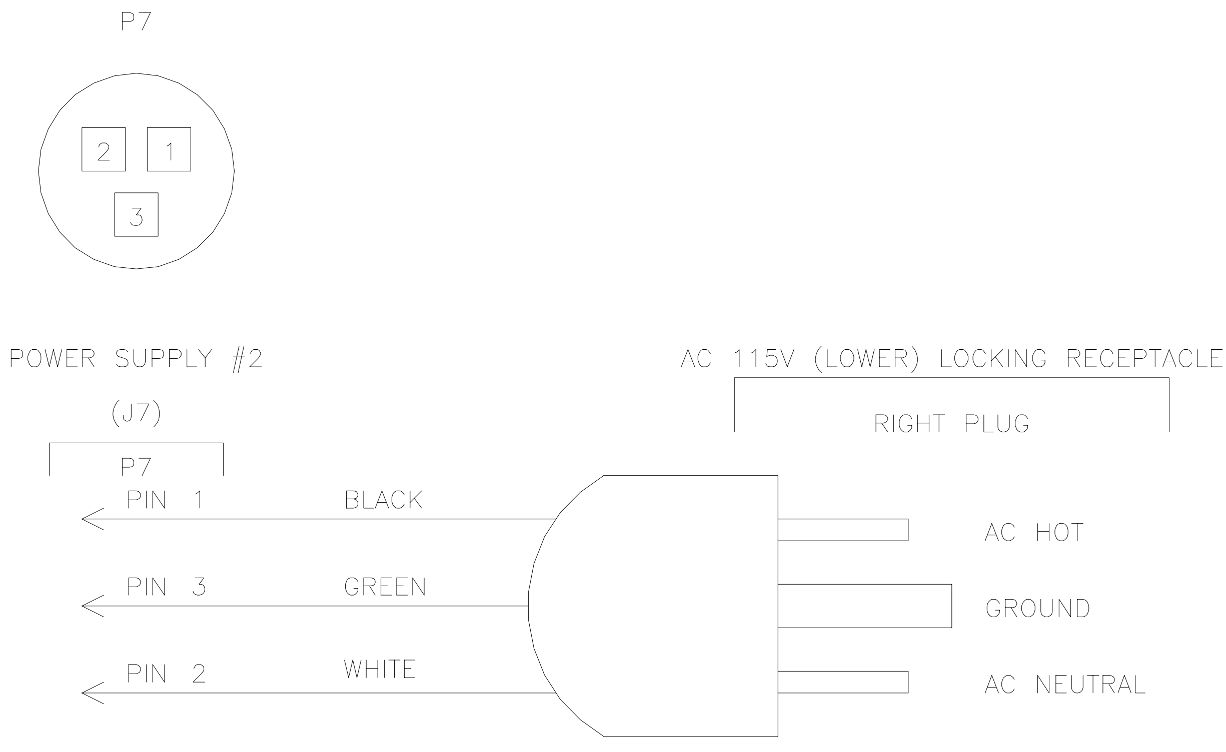

Figure A-14 Cable W13 Wiring Diagram (AC Line Voltage for PS #2)

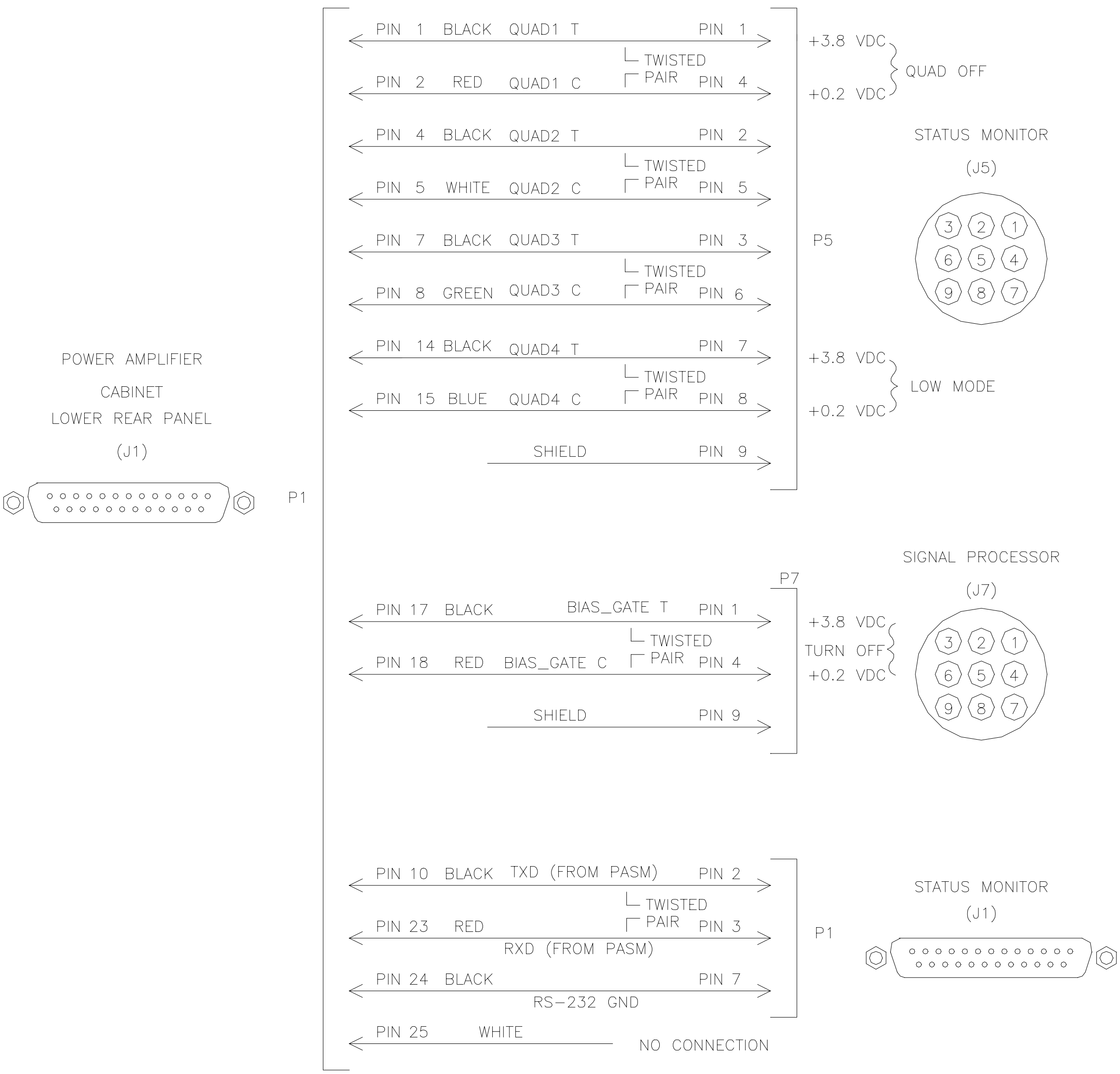

Figure A-15 Cable W14 Wiring Diagram (SP and SSM to Transmitter)

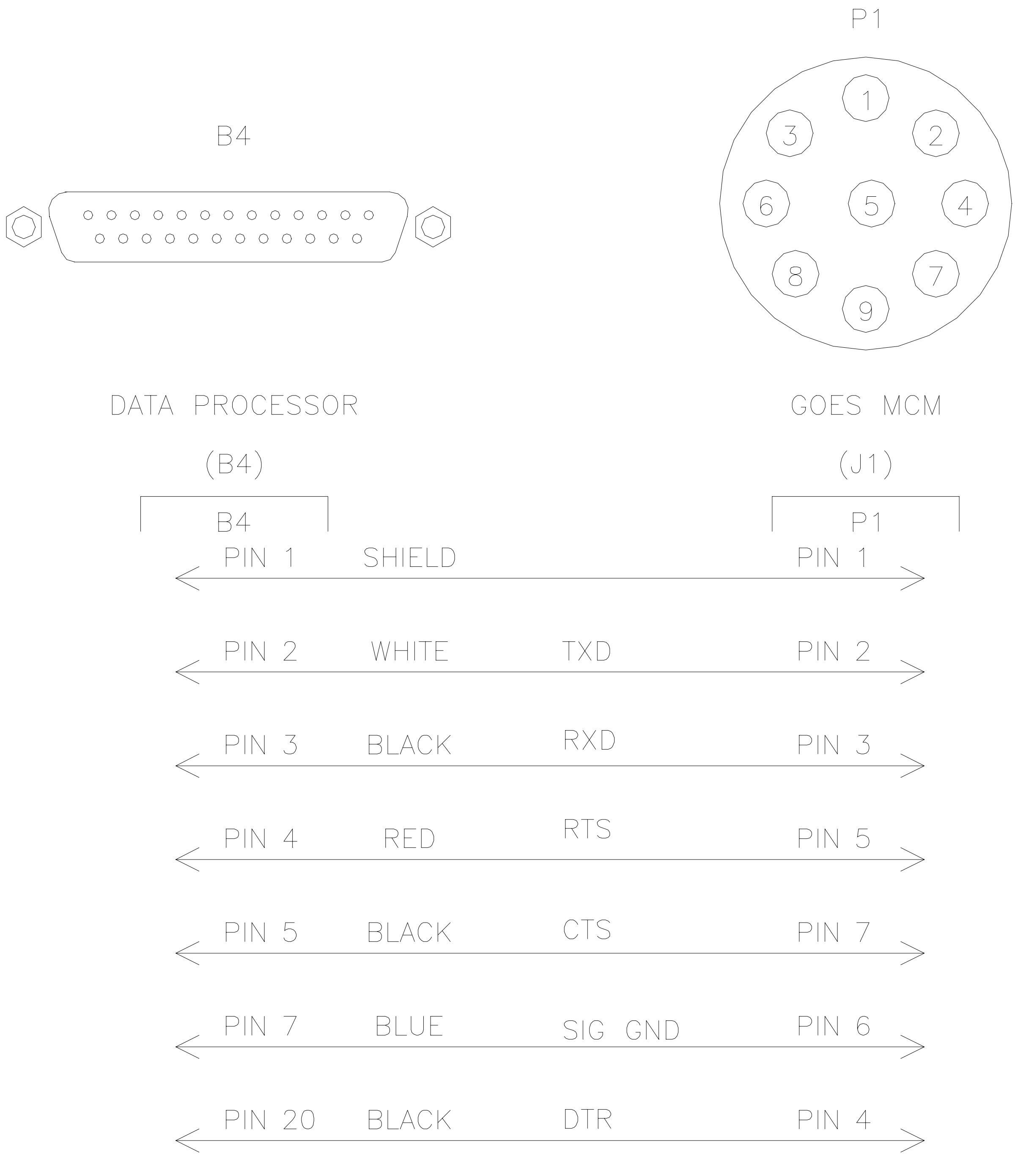

Figure A-16 Cable W15 Wiring Diagram (Data Processor tot GOES MCM)

APPENDIX B Site Visit Checklist

Standard Procedures for Site Visits and LRU Replacement

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1. Contact the Profiler Control Center (PCC) at (303) 497-6033 when you first enter the profiler shelter.

2. Verify that a replaced LRU is functioning correctly and the Profiler Hub is receiving data from the site by contacting the PCC after the unit has been installed and the site has been brought back on-line.

3. Provide the PCC with the serial numbers of the new and old LRUs, and include the manufacturer's model number and serial number, if available.

4. When you are ready to leave the site:

   a. Remove all jumper cables that may have been installed to disable shelter access alarms.

   b. Advise the PCC that you are leaving the site.

   c. Unless instructed otherwise by the PCC, verify that the air conditioners and exhaust fan are set at their normal operating settings.

   d. Perform a 5-minute delayed shelter access reset and log off the PMT.

   e. Disconnect the PMT cable from the front panel of the System Status Monitor. Failure to do so will eventually cause the Data Processor software to "hang-up" and effectively shut down the profiler. If the software "hangs", another site visit will be necessary to correct the problem.

   f. Unplug the PMT AC power cord from the wall outlet.

5. To lock the shelter the door, rotate the door handle from the "6 o'clock" position to the "9 o'clock" position and back again to fully engage the locking mechanism.

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APPENDIX C Acronyms and Abbreviations

**Commonly used Acronyms used
in the context of this document**

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Table 1:

Acronym	Definition
AC	Alternating Current
A/D	Analog to Digital
AES	Area Electronic Supervisors
BSU	Beam Steering Unit
CFE	Contractor Furnished Equipment
COHO	Coherent Oscillator
DC	Direct Current
DIP	Dual In-line Package
DP	Data Processor
DSU	Data Service Unit
DTR	Data Terminal Ready
DVM	Digital Volt Meter
EEPROM	Electrically Erasable Programmable Read-Only Memory
ECU	Environmental Control Unit
EFTC	Exhaust Fan Temperature Controller
EL-TECH	Electronics Technician
EPROM	Erasable Programmable Read-Only Memory
ERL	Environmental Research Laboratories
ESA	Electronic Systems Analysts
FFT	Fast Fourier Transform
FSL	Forecast Systems Laboratory
GPS	Global Positioning System
GSOS	GPS Surface Observing System
HPA	High Power Amplifier
LO	Local Oscillator

Table 1:

Acronym	Definition
LRU	Line Replaceable Unit
MARS	Meteorological Acquisition and Reporting System
MCM	Master Control Module
NLSC	National Logistics and Support Center
NOAA	National Oceanic and Atmospheric Administration
NPN	NOAA Profiler Network
NRC	National Reconditioning Center
NWS	National Weather Service
NWSTG	National Weather Service Telecommunications Gateway
PA	Power Amplifier
PCC	Profiler Control Center
PMT	Profiler Maintenance Terminal
PPO	Profiler Program Office
PSOS	Profiler Surface Observing System
RAM	Random Access Memory
RASS	Radio Acoustic Sounding System
RF	Radio Frequency
SARSAT	Search and Rescue Satellite
SBC	Single Board Computer
SPST	Single Pole-Single Throw
SSM	System Status Monitor
SIM	Serial Interface Monitor
STC	Sensitivity Time Control
T/R	Transmit/Receive
TTL	Transistor-Transistor Logic
TVSS	Transient Voltage Surge Suppressor

Table 1:

Acronym	Definition
UPS	Uninterruptible Power Supply
VAC	Volts Alternating Current
VDC	Volts Direct Current
VSWR	Voltage Standing Wave Ratio

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